Factory
MANAGEMENT AND MAINTENANCE

Vol. 94, NO. 3

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Factory Management and Maintenance is a consolidation of *Factory and Industrial Management* (including *"Factory"*) and *Maintenance Engineering*

Price 35c. a copy. Subscription rates—United States, Canada, Mexico and Central and South American countries, $3 a year. All other countries, $4 a year or 16 shillings. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Copyright, 1936, by McGraw-Hill Publishing Co., Inc., 330 West 42d Street, New York, N. Y.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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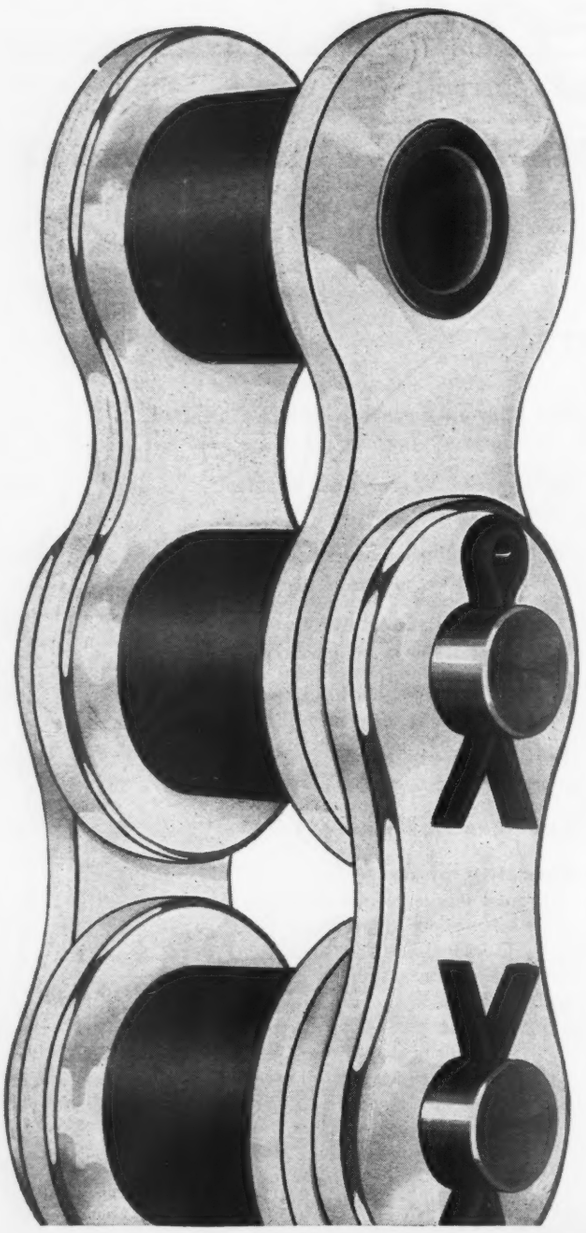
Factory Management and Maintenance, March, 1936. Vol. 94, No. 3. Published monthly. McGraw-Hill Publishing Company, Inc., 330 West 42d Street, New York. Entered as second-class matter March 17, 1933, at Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. by The Schweinler Press, N. Y.



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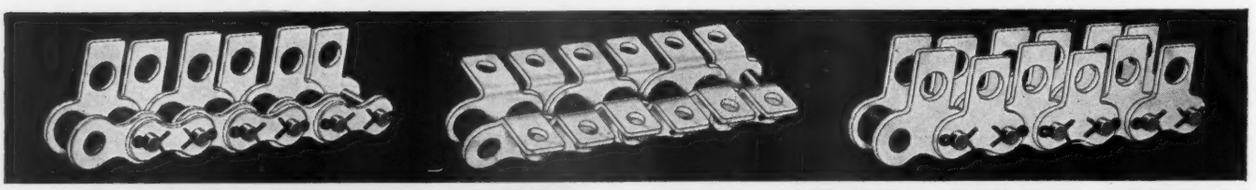

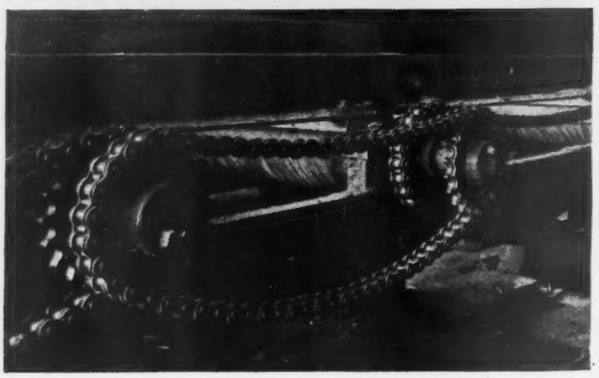

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Factory
MANAGEMENT AND MAINTENANCE

L. C. MORROW
Editor

Wanted: Personnel Managers

AS BUSINESS improves, management rebuilds working forces and supervisory organizations. Sometimes a good job is done, sometimes a bad. Good jobs result from the application of definite, far-sighted policies, bad jobs from hit-and-miss methods.

Two major kinds of questions crop up. One kind has to do with policies, the other with details.

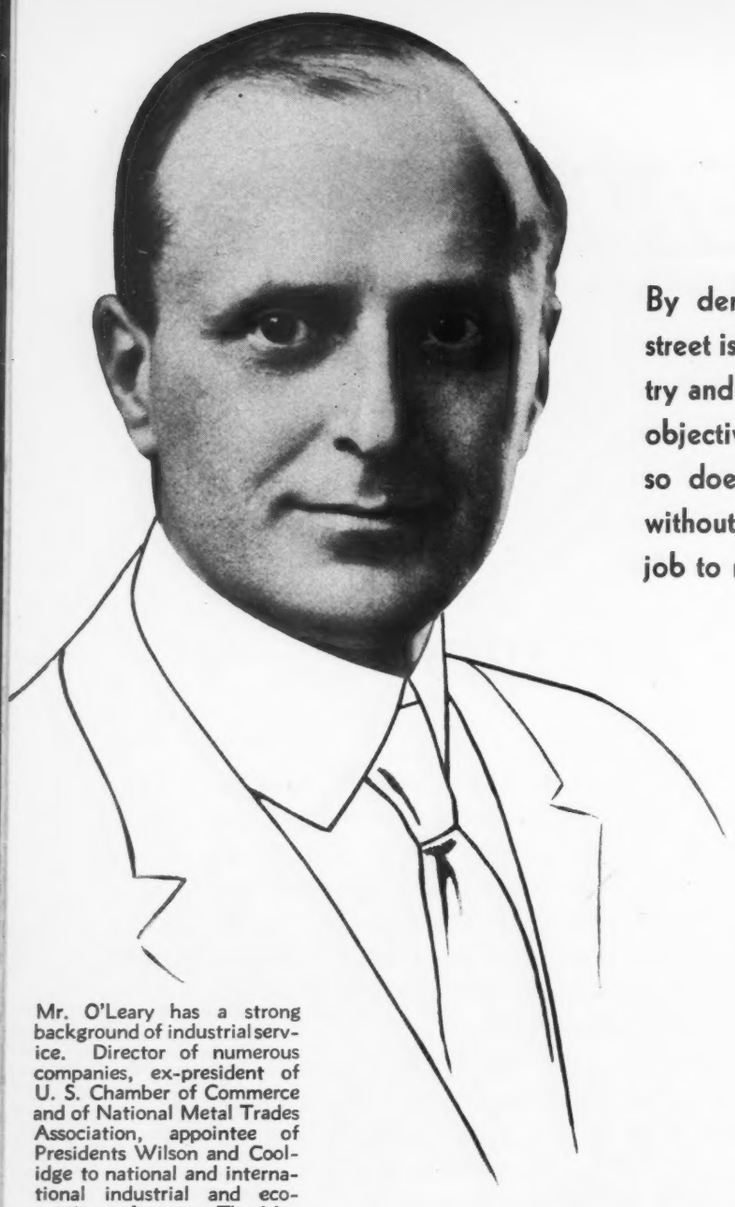
What procedures shall be followed regarding wage and salary rates, wage payment methods, representation for collective bargaining, seniority, promotion, training, education, apprentice systems, vacations, insurance, employee benefit or banking associations? These are policy questions.

How shall Mike be shown that he is *not* getting all the dirty jobs while Pete gets all the clean ones? How can Anna be convinced that her bonus really is the correct amount? What can this one do about an uncomfortable seat, that one a slippery floor? What causes this washroom grumbling; that lunchtime knocking? These are matters of personal grievance to individual workers. They are questions of detail.

There is no telling which kind of question it is more important to answer. Mike's and Anna's future may be wrapped up in the answers to policy questions. But Mike and Anna see only what's grieving them today. They may even be out and away for another job, or off on strike before the policy answer can be determined.

But both policy and detail questions exist, persist, and must be answered. It has been the experience of a convincing number of plants that correct answers are most likely to be forthcoming if it is the major duty of a capable individual to produce them. Personnel managers, as a rule, these people are called. When they are the right people for the job, are given the necessary authority, and are actively backed up by their executive associates, they very effectively do a job of keeping Mike and Anna satisfied and answering policy questions at the same time.

UPON a basis of need, even though not in fact, industry has out its "Wanted" sign for personnel managers.



Mr. O'Leary has a strong background of industrial service. Director of numerous companies, ex-president of U. S. Chamber of Commerce and of National Metal Trades Association, appointee of Presidents Wilson and Coolidge to national and international industrial and economic conferences. The Machinery & Allied Products Institute, of which he is now president, is a federation of more than 50 trade associations in the machinery field

By demagogs and politicians the man in the street is being taught that the objectives of industry and the public are opposed. Actually their objectives are the same. When one prospers so does the other; one cannot be penalized without the other suffering, too. It is industry's job to make this clear

Industry Has a

JOHN W. O'LEARY
President
Machinery & Allied Products Institute

MANUFACTURERS today face a problem of public relations unlike any that ever confronted them before. Good will is essential to progress for either individual manufacturers or industry as a whole, and lack of the emphatic support of it today is one of the principal handicaps to industrial recovery.

Industry, like every other section of society, has its ups and downs in public favor. One might say that the public must have its scapegoats as well as its heroes. In the days of Theodore Roosevelt, trusts received the brunt of public indignation. Organized labor, railroads, and public utilities have all served their terms as scapegoats, rightly or wrongly. College professors rose several hundred per cent in public approval a few years ago, but only to receive the criticism that goes with recognition. Today it seems to be the manufacturer upon whom the full stream of criticism for the nation's ills is poured. Every manufacturer feels it in his own community, and industry as a whole feels it throughout the country.

Judging from spoken and published expressions that come to my attention almost daily, there must be many who believe that industry alone should and could give jobs to 11,000,000 unemployed; that manufacturers caused the unemployment by instituting machine methods which somehow dispensed with the need for men; that industry can carry whatever tax burden the government cares to place upon it; and various and sundry other things equally absurd. Almost every problem of the day is laid by somebody at the feet of industry with the insistent question: "What are you going to do about it?"

Never before in history has there been any question about a manufacturer being commended by his community for rehabilitating his plant, expanding it, or making it more efficient. But undoubtedly many hesitate today to make desirable technological advancements because a change that dispenses with the services of a single individual, regardless of how many others it may provide with jobs, may incite the ill will of the public. Manufacturers who have always stayed aloof from political matters now find the very existence of their businesses endangered by new legislation. They can no longer sit idly by without taking a hand in the vital issues of the day which affect them so profoundly.

The voice of the manufacturing industry is the expression of a

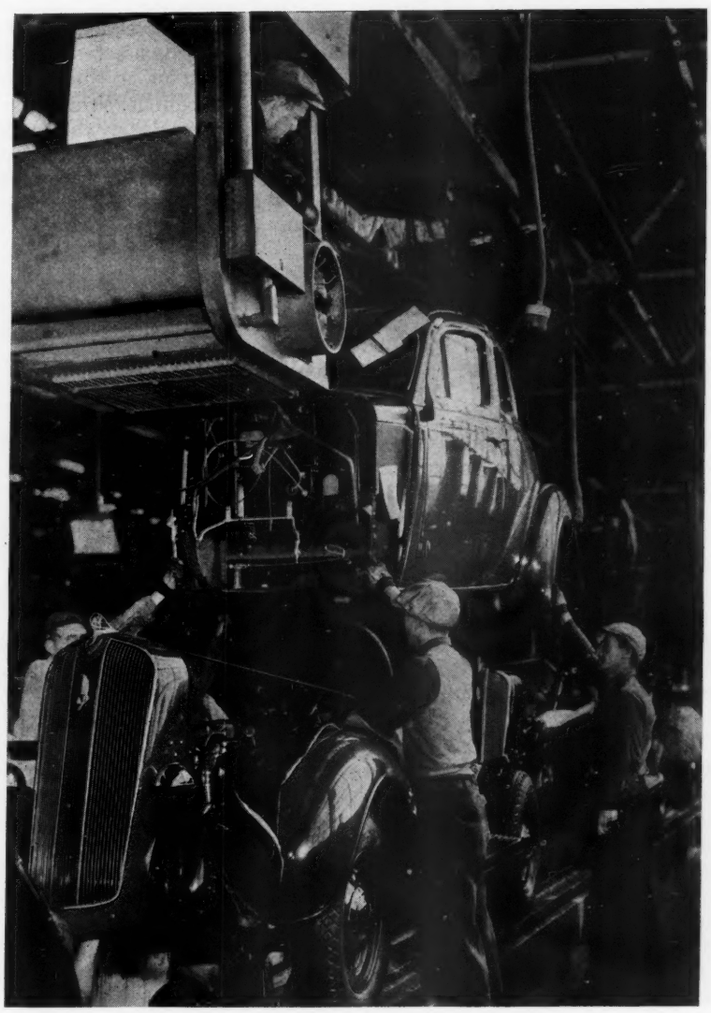
minority group. Important as manufacturing is, its employees constitute only about one-sixth of the entire working population of the country. Public officials usually cater to the popular side of important issues. If industry has one view and the public another, we know what happens. Fortunately that need not be the case. The objectives of industry and of the public are not opposed. The public relations job of industry is to dispel the belief of the man in the street that they are. When one prospers so does the other; one cannot be penalized without the other suffering too. Unemployment, technological advancement, taxes, government regulation—all are issues upon which industry and the public should agree. If the voices of industry and public opinion were suddenly in harmony instead of discord, many of industry's most perplexing problems relating to these issues would disappear. Legislators would no longer find opposition to industry a way to popularity.

Must Get Its Story Across

Misunderstanding is responsible for most of the unwarranted distrust. Let us consider what may be done about public opinion on some of the most important questions affecting industry. Americans are noted for their fair-mindedness, but on many current issues they are forming their opinions from one-sided propaganda. Industry, as well as the opposition, must get its story across if justice is to prevail. Every opportunity must be used to present industry's, and the public's side through the press, over the radio, and from the speaker's platform.

Take the matter of unemployment which is carried by so many to the door of industry. Normally the manufacturing industries employ about one-sixth of those gainfully employed. Today they are employing considerably more than one-sixth. The total number of workers engaged in manufacturing in 1929 was 8,838,743 according to the United States Census of Manufacturers. More than 7 millions are employed in manufacturing today. When the man in the street understands these facts he will see the absurdity of demanding that the manufacturing industries give jobs to whatever is the number of employables seeking work.

Public Relations Job to Do



JOHN SLEDD, Plymouth craneman, estimates that in seven years he has lowered 800,000 bodies (340,000 tons of steel) to assembly line workers. But for technological development—the machine age—what would John and the other 1,548,999 automobile workers be doing today?

While it is perfectly clear that manufacturers alone cannot give employment to all employables seeking work, it is not at all clear what the figure of unemployed employables actually is. There is a dearth of statistics on this subject, and all information we have is necessarily from estimates. These estimates vary greatly. The American Federation of Labor believes unemployment is about 11,000,000; the National Industrial Conference Board, 9,177,000. President Roosevelt has spoken of a fair estimate of unemployed employables as being 3,500,000, the number the WPA has temporarily put to work.

Perhaps if we had accurate figures of the unemployed at this date and were to deduct the unemployables and those who normally do not seek employment or seek only part-time employment, the figure would be about 6,000,000.

Let the "breathing spell" be

brought back and made permanent for industry, let normal business confidence and private enterprise continue to go forward, and 1,500,000 can be re-employed in capital goods manufacture. In consequence, as has been many times estimated, for each one so employed three others will be employed in furnishing raw materials, handling the finished products, operating the extra transportation facilities to haul them, and performing other tasks attendant upon capital goods manufacture. Six million men will go back to work, and whether or not that 6,000,000 will absorb all or less than all of the employables, we may be sure that re-employment will cease to exist as a major problem. With all we have to do and all we have to do it with, there is no room in America for predictions of a large and constantly growing body of citizens who want work and will not be able to obtain it.

1935 INDEX TO

Factory

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Address the Editor

There are volumes of material, comprehensible to the average citizen, on the fact that machine production has created jobs rather than increased unemployment, and that it has provided America with the highest standard of living in the world. Machinery is advantageous to manufacturer, labor, and consumer alike. Every manufacturer who institutes technological changes in his plant owes it to himself and the public to interpret these facts in terms of local conditions for his local newspaper.

From His Own Pocket

The man in the street who believes that higher taxes are all right so long as they are placed on industry can quickly be made an advocate of government economy, along with industry, if it is revealed to him that the ultimate source of all taxes is his own pocket, and that no matter where they are levied he pays them with his rent and when he buys bread, shoes, clothes, gasoline, and other necessities and luxuries.

Public opinion which favors regimentation of industry may be changed when it is made clear that this is but a step to countless other forms of regimentation affecting every individual in his daily life.

So it is down the line. What is to the best interests of industry is also to the advantage of the public. There is no place for class hatred in a democracy. Industry is charged first with the responsibility of conducting itself in such a manner that there are no just grounds for an adverse public opinion toward it, and second with the responsibility of doing its share toward dispelling misunderstanding, and protecting and advancing, chiefly through the influence of public opinion, the economic, legislative, and social principles that best serve both industry and the public.

"In this age, and in this country, public sentiment is everything," said Abraham Lincoln in his famous debate with Stephen Douglas at Ottawa, Illinois, in 1858. "With public sentiment, nothing can fail; without it, nothing can succeed. Consequently, he who molds public opinion goes deeper than he who enacts statutes or promotes decisions. He makes statutes and decisions possible or impossible to be executed."

These words are as true today as they were seventy-eight years ago. Unfortunately those who are opposed to industry have been more energetic in appealing to public sentiment than industry has, and both industry and the public are suffering the consequences today.

An Individual Responsibility

Industrial trade associations are charged with the responsibility of being fact-finders, interpreters, and spokesmen for their members on questions of national or sectional importance, and in general acting as mediators between manufacturers and the public. But every manufacturer has the individual responsibility of keeping himself informed on the vital issues of the day and in every way possible contributing to amicable relations between his own firm, industry as a whole, and the public. He cannot shirk this duty without paying dearly, as we are all paying now for the discontent that has been nurtured by those who oppose industry.

What Social Security Records Must Industry Keep?

REGULATIONS governing records to be kept by employers subject to tax under Title IX of the Social Security Act have been issued by the Bureau of Internal Revenue of the Treasury Department. The tax applies to the year 1936 and thereafter, but does not become payable until Jan. 31, 1937.

Every person subject to tax is required to keep a permanent record showing:

1. Total remuneration payable to employees in cash or any other medium, showing separately (a) payment for services exempted by the Act, (b) for services performed outside of the United States, (c) for all other services.

2. Contributions to state unemployment funds, showing separately (a) payments not deductible from remuneration of employees, (b) payments deductible, (c) payments with respect to services exempted by the federal statute.

3. Other information necessary to determine whether a tax is due and, if so, how much.

No particular accounting method or record form is prescribed. It is not necessary to show the number of persons employed each day, but the total for each calendar month, and the total remuneration for the same period, must be shown. Records must be available for inspection by the Bureau, and must be preserved for four years from the due date of the tax.

Any employer claiming exemption from the tax must have records to justify his claim including, where necessary, records of the number of persons employed each day during the entire year.

Stocking Up on Quality

Control of quality by "feel" or "looks," all too common with those who have to wrestle with natural materials, has been on the way out at Phoenix Hosiery ever since the company set up its new lab. The modern research approach has replaced rule-of-thumb fumbling. Seconds, once a major item of cost, are now of little moment. There aren't so many any more

★

H. P. DUTTON
Associate Editor

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ABOUT three years ago the emphasis in the silk hosiery industry, as in many others, shifted from the attempt to keep up with a seemingly ever-growing demand to the need for low costs with which to capture a share of a severely constricted market. Part of the campaign of the Phoenix Hosiery Company to meet the new conditions has been described in a previous issue.* In addition, however, to overhauling production methods and layouts and installing new equipment, one of the possibilities that seemed important was the reduction of waste by a more effective quality control.

Knitting Was an Art

Silk is an exceedingly delicate material. A natural fiber, it varies in its composition from lot to lot. It is hygroscopic, and the softness and elasticity of the fiber varies with every change in moisture content. In a knitted material, consisting wholly of a mesh of elastic loops, such variations may affect both the dimensions and the quality of the finished product. Add the complexities involved in conditioning the silk by chemical processes and the problems of making it take the dyes in a uniform manner, and perhaps you will see why the production of seconds has always been a major problem in the hosiery industry.

As in many another factory, the control of all these numerous variables had been left to Phoenix foremen. Silk knitting was an art, a very old art handed down from one generation of skilled workmen and foremen to another. There was undoubtedly a general skepticism among these men as to the possibility that scientific methods could add anything to these traditions of skill.

One possibility of reducing costs seemed, however, to lie in the application of laboratory methods to the control of production processes. A research department was therefore established, under the general direction of a reorganized inspection department, to see what could be done.

The new department was staffed by men fresh from college laboratories and familiar with research methods, although most of them were new to the industry and, in consequence, blissfully unaware of all the things that "couldn't be done."

This development proceeded in parallel with a reorganization of the inspection department, which while it continued to hold the foreman responsible for the work done in his department, supplemented his control by systematic centralized inspection.

It was only natural for the foremen to feel somewhat uneasy as to what looked like an invasion of their responsibilities and a reflection on the quality of their work. To counteract this impression, Saturday morning meetings were held once a month, at which papers were presented by members of the new departments, as well as by foremen, dealing with the problems of hosiery making. These meetings not only served to get all members of the organization to thinking about quality and economy, but they enabled the management to present the new departments for what they really were—new tools making it possible for operating de-

ESSENTIAL ELEMENT in Phoenix Hosiery program of quality control is its research and testing laboratory which has so successfully maintained uniform quality of dyes and silks

*"They Invested $250,000 to Save a Million," *Factory and Industrial Management*, January, 1933.

partments to turn out better work.

The conduct of the new departments bore out this promise. When a difficulty or a defect came to light as the result of inspection, the department immediately took up with the foreman concerned the possibility of remedying the trouble. In addition to a 100 per cent inspection of all hosiery before it went to the customer, a periodical spot check was made of the work of every operator in the factory, at intervals depending on past records of trouble but not less than two weeks apart. Monthly reports were made to all foremen of defects chargeable to individual operators, particularly at the bad spots, enabling them to find the weak points in their own organizations and to correct them by instruction or other methods. Complaints from customers were also carefully analyzed.

The inspection department was thus constantly producing a grist of new problems for the foremen to solve, but at the same time stood ready to help in their solution. The research department, particularly, was in a position to give the foremen material assistance.

For example, the first process in the treatment of the raw silk is "softening." Natural silk, while usually uniform within a lot of 10 bales, varies considerably from lot to lot in the hardness of the fiber and, consequently, in the way it takes the dye and handles in spinning and knitting.

This silk is brought to a uniform condition by immersion in a hot bath of saponified oils and other components in water. In the control of this important process, upon which depended so much of the quality and uniformity secured in later operations, it had been the custom for the foreman to make up the bath as needed, varying the formula to correspond with the feel and hardness of the silk.

Baths by Formula

The research department got after the process. Among other interesting facts, they found that the activity of the bath was importantly influenced by small variations in its relative acidity, or what is known as its pH factor. And the foremen, in making up the bath, had been using water from the city mains which, tests showed, varied from day to day in percentages of lime and other dissolved salts.

Mixing of the bath was put under laboratory control; pH measurements were taken of a day's supply of water at a time and the bath was mixed according to formulas supplied daily by the laboratory. As a consequence, the uniformity and control of softening have notably improved. Indeed, the control is now so dependable that the purchasing department no longer feels it necessary to limit its silk purchases to a few filatures in order to secure a product the factory can handle; so long as the silk meets the other tests of quality, variations of hardness no longer offer difficulties.

Many other examples could be given of the fruitfulness of this three-sided cooperation of foreman, inspection department, and research man. For example, trouble was experienced in throwing or twisting the silk yarn. A re-design of the cones for freer unwinding reduced breakages and machine stoppages from 30 or 40 to 2 or 3 per week.

Clipping the loose ends of silk in finishing the foot used to be a troublesome job, until someone worked out an ingenious combination of vacuum cleaner and hair clipper which in one operation lifts all the loose strands and clips them off without further ado.

Details, such as the spotting of silk by excessive condensation of steam in a manually controlled oven, began to come to light. A new oven was installed; a bell rings when it has been brought to the exact temperature and humidity required to set the twist in the silk after coning. Quality at this particular point no longer depends on the chance of the worker's being distracted and run-

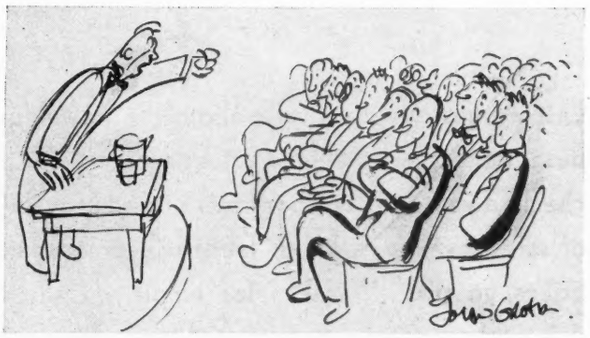
(Continued on advertising page 40)

INSPECTING work from the leggers. At intervals of not more than two weeks, samples of the work of every operator are inspected. Defects are made the occasion for instructing operators, or for remedying faults in equipment or materials

If the worker only knew

Would he like the Labor Law?

★



. . . I heard that union fellow the other night . . .

BIG ED and Sam, planer hands, are taking on a little energy in the form of Swiss on rye, with a glass of dark. They are also relaxing between the evening whistle and overtime.

"Just what is this Labor Relations Act, Ed? Is that the same thing the papers called the Labor Disputes Act and the Wagner Bill? And what does it do, anyway?"

"All the same thing, Sam. One rose with three names. Or maybe I oughtn't to call it a rose. Don't think it's as sweet as all that."

"You mean it ain't so good for us workers? I heard that union fellow the other night—he said it was going to fix everything up for us, that now we'll be able to get what's coming to us, because the law's back of us."

"Yes, I know how they talk. But we have to take those things with a grain of salt. You asked me what it does. I'll tell you and then you can see how you feel about it. First thing it does is to set up a lot of unfair labor practices."

"Things it's unfair for us to do?"

"No, things it's unfair for your boss to do. For example, he mustn't interfere with workers' forming or joining labor organizations, or bargaining collectively. Then he isn't permitted to contribute help to a labor organization. And he isn't supposed to hire or fire a fellow because of his labor affiliations."

"But those things don't seem so bad, Ed. That all?"

"No, not all. According to the law our boss may agree that anyone must belong to a particular labor organization if he's going to work here, provided that organization represents over 50 per cent of our employees."

"That doesn't mean that we have to belong to a union, does it, and pay dues, and go on strike?"

"It means that we *might* have to belong to a union. And if we did, of course we'd have to pay dues. And we might have to go on strike—be mighty uncomfortable for us if the boys called a strike and we didn't go out."

"And I suppose that means we might have to go on a sympathy strike, because workers in some other plant and their boss couldn't get along together?"

"Sure. And if we didn't go out, we might have some of those flying squadrons around—and some broken heads."

"Well, suppose our company had a Works Council, Ed. Would we have to belong?"

"Yes, if over 50 per cent of the employees belonged, and the boss agreed that everybody had to."

"And would we be any better off?"

"*I* think so, Sam. I imagine we could settle our troubles without a strike. But if we couldn't, it would be our own private strike. There wouldn't be any outsider calling it."

"How do we know who represents us? Course I see that if we tried to have a Works Council we'd get everybody to vote. Would the union work that way too?"

"No, not at first. They'd get their fellows into the plant and try to get us to join. Then when they thought they had enough, or could make an impression, they'd claim they represented the force and probably make demands on the boss. If he refused, chances are they'd ask the Labor Board to hold an election."

"Then could the Labor Board issue orders?"

"Oh, yes. And the whole situation could get into the courts."

"Looks like a mess, Ed. But I suppose it would be worth while if we workers got higher wages out of it."

"I doubt even that, Sam. You know you can't get blood out of a turnip. The plants we work in can't pay out enough to keep them in the red all the time—and the more expenses they pass on to the consumers in higher prices the less business they'll have. So we might all lose out in the long run. And another thing. The more we're organized the closer we all come to getting the same wages. Believe me, I know I'm worth a lot more than some of the fellows we work with. I don't want to go down to their rate and I don't want them brought up to mine until they can do as much as I do."

"'Bout time to go back, Ed. One more question. You mentioned unfair labor practices for the boss. How about employees? Aren't flying squadrons, and threats, and other things we know about unfair?"

"The law doesn't say so, Sam. And they get away with 'em, don't they? For my part I don't want any. I've always managed to make pretty good money and I think I'll try hard to keep on doing my own bargaining. Let's go."

•

More fundamental facts in palatable form—to offset crackpot theories. Earlier articles dealt with the 30-hour week and the Townsend Plan. We think you'll do well to make all three available to workers—can arrange to distribute them for you

•

26 Pay Checks Later

★

Last August we told you about the new Nunn-Bush wage plan that guarantees workers 52 pay checks a year, makes labor costs a fixed proportion of sales revenue, adds to labor's income as shoe prices go up. It makes for employee security if it works. And how is it working? Here's the answer after six months af operation

★

An interview with
HENRY L. NUNN
President, Nunn-Bush Shoe Company
Milwaukee

SIX MONTHS ago, as this is written, we entered into a contract with our employees along lines explained in a previous article. Briefly, this contract provided that every employee was put on an annual salary that guaranteed him 52 weekly pay checks during the year, these pay checks subject to revision upward or downward if the company's gross income, or total sales, should vary materially in either direction. These salaries to be paid out of an appropriation budgeted for labor cost, based on a fixed percentage of the estimated year's gross income to the company. The salary fixed by dividing 52 into the employee's previous earnings in the 48 weeks that had been our year's average employment in the factory, with provision that any employee working more than 48 weeks during the year, or working more than normal hours, be paid for this additional time. And the further provision that any economies in wages might be attained through greater productivity than forecast would be divided among the employees at the end of the year in the form of a lump sum called adjusted compensation.

The plan went into effect on July 3, 1935. Within four months we were beginning to discuss in a general way the alteration of this contract to take care of certain changes in business conditions and of objections that had become apparent through the experience in this period. When these changes had been discussed with the representatives of the shop union and worked out to the mutual satisfaction of themselves and the management, they were submitted to the vote of the workers by the shop union. The changes were adopted, and since January 2, 1936, we have been working under the revised contract.

Whether Shoes Go Up or Down

A major provision of the original contract was that the salaries were set to figure out to a definite percentage of the company's gross income. Experience over the years had shown us that this percentage was about constant, whether the price of shoes went up or down. If therefore the price of shoes should drop sufficiently to affect us, we reserved the right to adjust salaries downward to hold them at this fixed percentage of our total sales. Similarly, if shoe prices should rise, we were obligated to adjust salaries upward in the same ratio.

At the time the contract was made, we looked for a probable increase in the price of our finished product. We did not, however, foresee so rapid a rise as was made necessary by the shift of business conditions during the last half of 1935. Consequently, no sooner had we embarked upon operating under the contract than shoe prices began rising and it became apparent that employees would soon be entitled to an upward revision of their salaries. This was the basic reason why it seemed desirable to do something rather promptly.

The principal weakness in the old contract, as it developed, was that it required a little greater mathematical ease than some of the workers seemed to possess. This was on account of the provision that what had been a year's income, namely the pay for 48 weeks of 40 hours each, became the base rate for the year's salary, and that this basic year's salary was thereupon divided into 52 parts for computing the weekly salary. In other words, the weekly salary became 48/52 of the old pay check for a full week's work. It was difficult for some few of the workers to comprehend that this did not constitute a pay cut.

A worker who had been getting, let us say, $30 for a full week's work, and had been averaging 48 weeks a year, earned $1,440. Divide this by 52, and we arrive at a weekly salary of $27.69. Actually the worker is getting the same number of dollars during the year by this arrangement, and his budgeting should be materially simplified through getting the pay check of equal size every week in the year. Regrettably, a few workers could see only the reduction of $2.31 in the pay check when they had worked a full week, and completely overlooked the weeks under the pre-contract arrangement when they had had only part time, or no time at all.

No Arithmetical Hurdle

When we came to making the upward adjustment needed at the end of the year, we decided that the best interests of everybody would be served by taking this arithmetical hurdle out of the plan. So, instead of working it out on any other basis, we simply increased each worker's weekly check to the amount necessary to restore his weekly income to what he had previously received in the weeks when he had worked full time. Thus, our hypothetical worker cited above no longer draws $27.69. Instead, he gets a weekly check of $30. With this complication removed it is entirely comprehensible to every man and woman

in the plant that he or she is now better off than before the contract or during the 1935 contract.

No Mental Gymnastics

If it may be permitted to make a detour from the main subject of this article, let us urge out of our experience that, whenever you are drawing up an agreement with your employees, you do it in the simplest possible terms. It is not enough that the workers' representatives "get" the plan, or even that it be clear to the men in the factory with whom you may discuss it. All of these are likely to be a little more adept at mental gymnastics than is the boy who inks heels, or the man who has just come into the organization—and it is important that they too understand, lest they become a focus of dissatisfaction.

Our fundamental reason for believing that our wage plan is practical is that it seems the one way to make ourselves do the best possible job of managing the business along lines which should be most useful to the general public, most satisfactory to our employees, and most profitable to the stockholders. The plant that pays its workers on piece rates has little incentive to level out production, since piece rates amount to a guarantee of level labor costs per unit of product. The plant that pays its workers by the week can easily cut its payroll by the simple expedient of working the factory only a few days a week. But the plant that has to pay its people 52 times a year in equal instalments, can effect a saving in wages only by negotiating this with the workers' representatives, and thus has a sufficient incentive to keep business flowing along so that such negotiations will not become necessary.

Another lesson learned from our first six months under the 52-week contract is that it is best to set the scale so that not too large a share of the worker's total income will come in the form of the adjusted compensation. Adjusted compensation, you will recall, is the worker's pro-rata share of the total labor economies effected over and above the budgeted allowance. We issue weekly bulletins on plant bulletin boards showing the workers exactly how they stand in this respect—that is, that the sum available for adjusted compensation stands at so many dollars, as compared with so many dollars last week and the previous weeks.

More by the Week

As the sum increased, we recognized an opportunity of paying a large proportion of their earnings by the week instead of at the end of the year. Some of the people could not altogether understand why they were not getting this money then without delay. The reason, as we figured it out, is that when an individual is in receipt of an income no greater than most factory people receive, he must of necessity live financially in the present. He cannot, strictly speaking, afford to take any considerable proportion of his income in a lump sum that has been deferred from his weekly pay. The consequence is that we are planning hereafter to set our weekly factory salaries somewhat closer to the amounts that we expect will be the eventual earnings.

By present outlook it seems probable that the cost of living will rise for a while at least. The price of shoes always holds a very close relationship to the cost of living. Therefore, if living costs rise, it seems probable that the prices realized for our product will increase. This means, of course, that under our contract we shall be raising the weekly salaries of our people while the upward trend continues. This first adjustment, after six months of the contract, is likely to be only the first upward move.

Complete Assurance

The reaction of our factory people to this adjustment has been exactly of the sort we had looked for and hoped for. They have accepted the raise not only as a welcome addition to their incomes, but also as a reassurance to their natural conservative reservations about any new and untried plan. They have now seen the plan, in actual practice, give them the increase that it provides for. They have seen that we have willingly initiated a new contract that not only raises their pay and provides for any future raises on the same basis, but also eliminates some of the aspects which were less easy to understand. And it seems a safe assertion that they feel complete assurance that as conditions change in future, they will get the benefit of any improvement without having even to ask for it. Incidentally, in their shop union referendum, they ratified the new contract by a vote of 44 against to about 650 for.

For our part, we have every confidence that when and if it ever becomes necessary to make a downward revision in the salary scale —which can come only with a decrease in the market price for shoes or decrease in our business—the employees will meet us just as willingly with their concession. To be sure, I should normally expect that if such a cut were put to a shop vote, there would be a slightly higher proportion of votes against it, but not excessively so.

Our experience to date with the 52-week pay plan is entirely favorable. We have, as outlined above, ironed out the few small wrinkles which we have found in actual practice. And our opinion, after this half-year experience and this set of comparatively small changes, is that the plan is at least as inherently strong as we believed when we adopted it last summer.

FIGURE 4. For careful analysis of an operation, the motion camera is a tremendous help. In this instance, the new "gage and inspect" operation was filmed and analyzed, and from that analysis the process chart on the facing page was constructed

"Gage and Inspect"

2. AFTER MOTION STUDY

★

G. J. STEGEMERTEN
Superintendent, Time Study Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Last month, how a preliminary saving of 40 per cent in time, made possible by switching a job from day-work to incentive, was increased to 52 per cent through the application of time study principles. . . This month, how motion study saved another 37 per cent!

FIRST STEP in motion-studying this job of "gage and inspect" was to make a process chart of the old method. This chart was exhibited in connection with the first half of this article (February, page 67), and shows the movements of each hand for each element of the operation. Study of the chart, therefore, gave a clear picture of what the right and left hands were doing, and provided a complete line-up of the elements necessary to perform the job under observation.

The first thought stimulated by a study of such a chart should be, as it was in the case under consideration: "What kind of set-up can be made so that the motions of both hands will be the same but made in opposite directions over symmetrical paths while performing useful work?"

Answers will vary with the analyst. The methods man may visualize many possibilities, but some of them will seem doubtful and only experiment can prove their value as practical shop methods.

For example, analysis of the "gage and inspect" job brought out at once the possibility of eliminating the need for two operations by placing the two bushings on plug gages while the operator still held them in her hand. There was a general feeling of doubt, however, as to whether or not this would be possible. Because of the small tolerances, it seemed to be necessary for the two hands to work together, one with the part and the other with the gage in order to prevent sticking. Success lay in positioning the plug gages in such a manner as to give the arms and parts rigidity from the body in order to start the parts on the gages.

When the possibilities of a proposed method have been proved, the next step is to construct a process chart for the new method. In this instance, the proposed method was filmed and then analyzed (see Figure 4). The new chart is shown in Figure 5.

It will be recalled that in the old method the bushings were placed on the bench with the gages between the operator and the parts. With parts lying on the bench in this manner, a repetition of removing them one by one gradually takes the parts out of the shoulder area, and either the movement becomes a fatiguing hip motion or the opera-

tor has to delay periodically in order to pull the parts closer.

The new arrangement provided for an inclined chute feeding the material to the hands at a vertical distance from the table equivalent to the distance between the wrist and the elbow, and directly over the gages. This chute is shown in Figure 6. It was not possible entirely to eliminate the shoulder movement, but the distance was reduced from 24 to 8 inches. Also, as the bushings are taken from the chute, new ones feed down so that the operator is always able to pick up parts from the same place, which does away with much fatigue and delay.

Note also—referring again to the process chart of the new method—that all elements have been combined into one operation, which eliminates one occurrence of "lay part aside" and "pick up part."

In the old method, after plug gaging, the operator placed the part in a tote pan on a stool beside him (see Figure 1, February, page 66). The new method provides for drop delivery to a tote pan directly upon removing the parts from the plug gages. Thus a shoulder movement of 24 inches was replaced by an ordinary elbow movement of 10 inches.

A study of the exhibits will reveal other changes that were made. Results of the motion study were a further reduction in time of 37 per cent—and, just as important, an easier and less fatiguing operation.

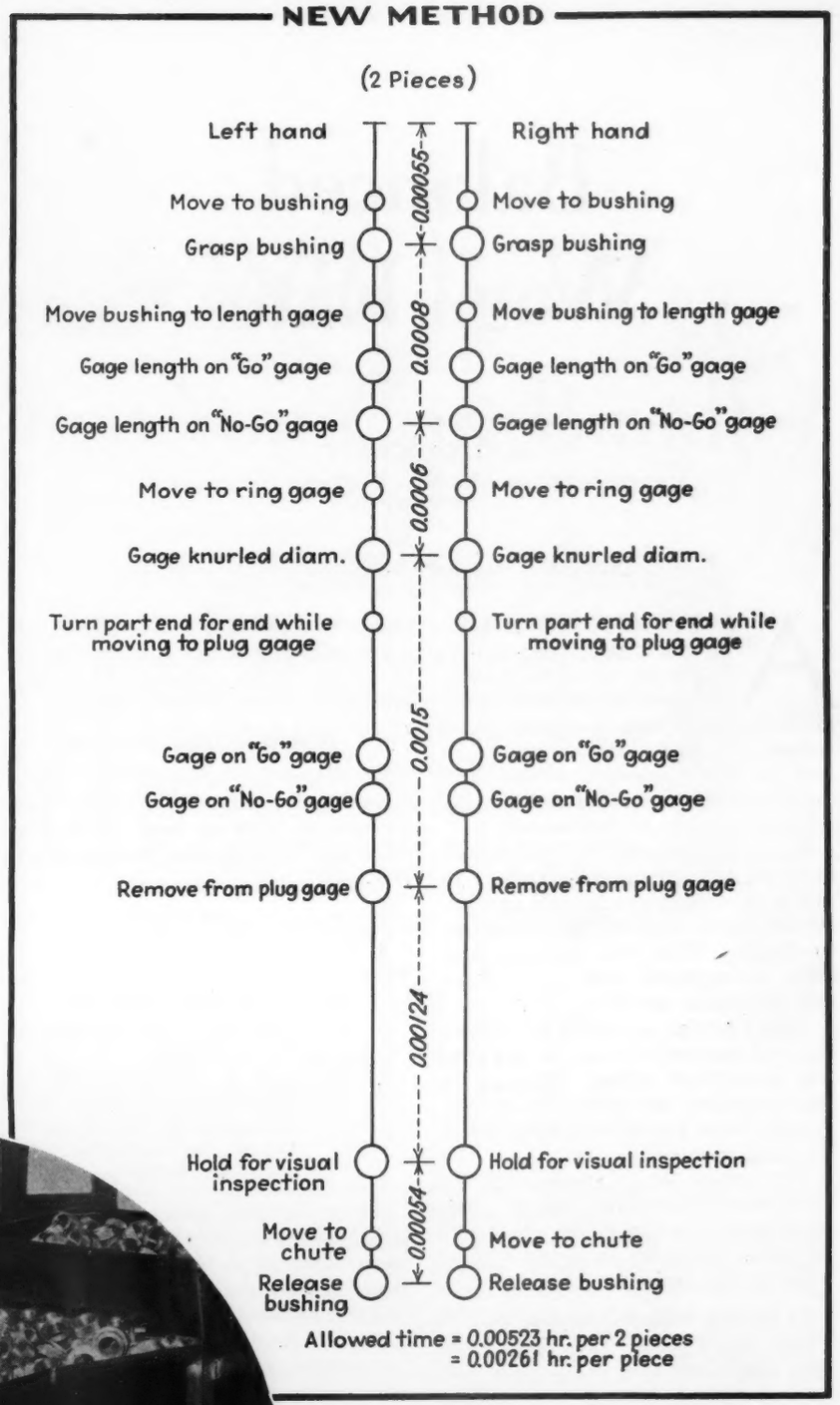


FIGURE 5. Process chart of new method. Note that there is now only one operation. One occurrence of "lay part aside" and "pick up part" has therefore been eliminated. Time per piece has been reduced from 0.0041 to 0.0026 hr., a further saving of 37 per cent over the 52 per cent saving that had already been made

FIGURE 6. New method showing how plug gages are set up so that the operator may inspect two bushings at a time. Note also how parts are fed to within easy reach of the operator. And observe that drop delivery to tote boxes under the work bench has been provided

Balanced Wage Rates

H. G. CROCKETT
Engineering Partner, McKinsey, Wellington & Company
New York

★

A MANUFACTURER of metal products employed in building construction used wage payment methods designed to reward each man in proportion to volume produced. Yet it was apparent to management and men that there were serious inequalities in the relative rewards of individuals.

So, in the interest of profits and fairness, this company undertook to grade all workers as to skill and all-round worth, and to pay them accordingly. With this change made, both management and men agree that the rates are fair.

I shall confine myself to describing the realignment of rates in one typical department where, although all the operations are performed on machines, there are wide differences in the skill required.

The entire job of realigning the rates was broken down into five distinct steps, most of all of which will be found necessary in doing similar work in any factory. They are:

1. Setting Departmental Base Rate

The departmental base rate is one that will result in a given total payroll for the department. In this plant it is somewhat higher than the rate paid for similar work in the community in order to attract and hold a high grade of help.

2. Determining Skill Requirements

To avoid having a large number of rates dependent solely upon skill requirements, operations are classified into comparatively few groups, each calling for a similar degree, although often a different type, of skill. Skill factors considered were education, experience, physique, dexterity, and special skills. Differences, that is to says "increments," in the rates between groups were set to reflect as accurately as possible the differences in group skills—without, however, resorting to fractions of cents.

3. Establishing Group Base Rates

To determine actual group rates, knowing departmental base rate and increments between base rates, the following arithmetical computation was used:

$$r = \frac{RO - T}{O}$$

where r = lowest group base rate
R = departmental base rate
O = total number of operators in the department
T = total of all rate increments above the lowest group base rate, multiplied by the number of operators receiving each rate increase.

This formula gave the lowest group base rate. Higher group rates were determined by adding the various increments.

To show how this formula is used, consider a department in this plant, the figures for which I have changed slightly to make the calculation more easily apparent. It consists of 30 men at the lowest group base rate, another group of 20 at an increment of 15c. an hour above the group base rate, and another of 10 men at 30c. an hour above the group base rate, making a total of 60 men in the department.

The management decided that, considering going rates for similar work in the community, the base rate for this department should be 60c. an hour. Substituting in the formula:

$$r = \frac{(60 \times 60) - (20 \times 15) + (10 \times 30)}{60}$$

which gave us a base rate of $r = 50$c. an hour. Adding the increments for the two other groups, we find that we now have 30 men at 50c., 20 men at 65c., and 10 men at 80c. an hour.

4. Rating the Value of Each Workman

To insure that workmen would be paid all they deserved and that the employer would get all he paid for, it was necessary to set the rate for each workman on a merit basis.

In this plant there are six qualifications that determine the worth of the man to the company. They, with the merit point ratings determined upon after careful study, are shown in Table I. The first five of these considerations are readily determined with reasonable accuracy. Only the sixth is dependent upon judgment alone.

Standards of performance for each operation and per cent of standards that each workman obtains are available. Merit points for production as to quantity are determined from Table II.

Quality of production is determined by the foreman and the inspector. Workers who are considered very accurate and thorough are

(Continued on advertising page 41)

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Jim Jones, 10 years on the job and an asset to any organization, certainly ought to get more money than Jack Smith who came to work a few weeks ago and is just another fast worker. If wages are based on output, he may not. Yet from the standpoint of good labor relations, it is important to maintain such differentials. This concern does it by rating employees as to skill and all-round worth, pays them accordingly, gets more output, and—equally important—better quality.

Why Break When You Can Bundle?

Six years ago this concern began to ship in bundles of steel-strapped cartons. Product hadn't changed. But merchandising technique and buying habits had. Today the customer saves on the freight, and bills for breakage aren't what they used to be. Modern packaging is part of any plant's program to deliver a better product at lower cost

★

JOHN K. CRIPPEN
Vice-President, L. B. Allen Company, Inc.
Chicago

AN IMPORTANT tendency in modern merchandising is toward the adoption of small compact packages and cartons. Bulkiness, whenever possible, is being systematically eliminated, and the more attractive, more easily handled carton is being substituted. Lessened weight and uniformity of size make it possible for the manufacturer to give speedier shipping service at lower handling cost per unit of product.

I was interested to note, in a recent advertisement in "Mill Supplies," that small cartons, each containing a uniform number of drills, were offered in different colors, each color denoting a certain type of drill. Thus the tendency is acquiring new and interesting aspects from the merchandising standpoint.

In my estimation, some of this progress may be credited to the humble steel strap—a product which appears to have revolutionized packing, handling, and shipping methods as surely as it has upset older, bulkier packaging traditions.

There are several good steel straps and applying devices on the market, in many widths and gages, suitable to almost any requirement, and making possible all types and kinds of "bundles." Bundle is the apt name that has been given to a group of steel-strapped cartons.

Glass Jars Are Safe

During six years' experience with steel-strapping our breakage in shipping has been greatly reduced. We have applied the method to shipments of liquid in glass jars, tubes of various adhesive materials, powdered materials in jars, paste in tin cans, solders for various types of metals, and even caustic products in tin cans. Dealers' displays, protected with shredded cellophane, are shipped to the East Coast, West Coast, and Canada without further protection, although they are fragile tubes mounted on cardboard.

Probably our soldering salts gave us more trouble than any other product. These salts were formerly packed in cases. The boxes had to be nailed many times, and were filled with sawdust or excelsior. Neither is now used, and the salts are sent out simply in re-shipper cartons, six or twelve to the carton, bundled together with two steel straps.

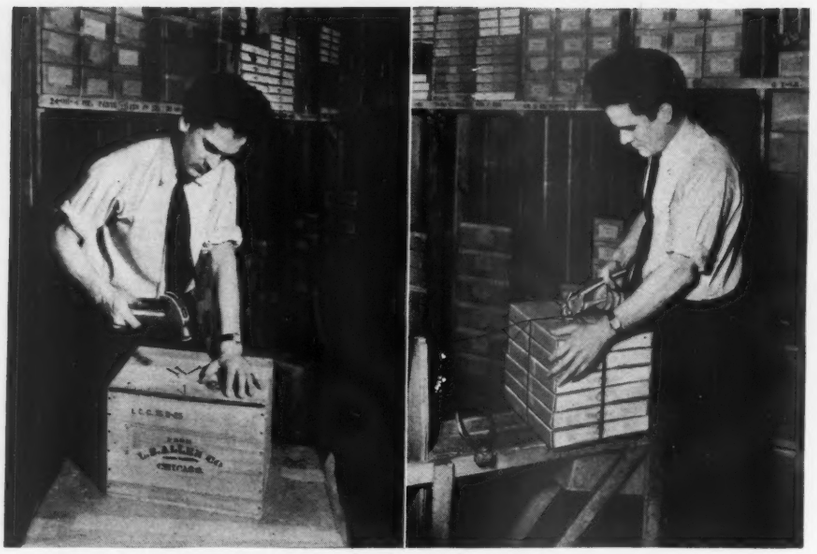
Thus one bundle has supplanted the old-fashioned case, and at the same time breakage is seldom encountered. Of course the jobbers appreciate this method of packing, because a pair of snips is all that is required to "unpack" the shipment, and the cartons are ready at once for the shelves.

We have found that steel-strapped bundles have a resiliency not possessed by the rigid wooden box, despite the greater strength of the wood. This means economy, therefore, not only in shipping costs, but in replacements, because one bottle, breaking in a wooden case, would often ruin an entire shipment.

For Fragile Items

There are several ways of affording a shipment additional protection, when the carton itself does not suffice. The bundle, of course, lacks the rigidity of the wooden box, and the bundles tend to flex in dropping, thus distributing the impact over a wider area. Nevertheless, with exceptionally fragile articles, special precautions are taken.

With such merchandise we use, in the first place, a carton with a high



STEEL-STRAPPED bundles replaced wooden boxes six years ago at L. B. Allen Company, Chicago. Costs less, in this concern's experience, to ship that way. Freight charges are lower. Breakage is no longer a serious item

poundage test. Articles inside (for example, a five-pound jar of soldering salts or drainpipe cleaner) may be wrapped in a corrugated tube before being slipped into the carton, or a special sleeve may be provided by the box maker.

With unusually large bundles, reinforcement is provided by means of wooden slats—two or three to each side. The steel strap is run in the center of each slat, tacked securely in place with U-staples. Then, to provide extra rigidity, crossing straps are fastened together by means of special seals, which hold them tightly in place.

With most shipments, however, we have found that the only protection necessary has been a good sturdy carton, and possibly an extra liner. With glass jars, packed a dozen or less to the carton, separators keep the jars from hitting against each other in transit. We ordinarily use only two straps for bundles of from four to six cartons, and three straps for larger bundles.

A large number of cartons may be formed into a single "bundle" with sufficient protection, though the ease of thus binding them together does not make it feasible to bundle ordinarily more than four or five fair-sized cartons for out-of-town shipment, or six cartons for local shipment. Railroad, barge, express, and trucking rates are now adapted to this type of shipping.

How Many Cartons to Group

Before a definite grouping of cartons is taken as standard, the shipper should make a few tests, subjecting the bundles to intentional abuse. The right number will show no severe strain, even when dropped from heights of four or five feet, from various angles. It will not take long to discover the proper number of the various sizes and types of cartons for the various bundles, although a little extra protection, such as I have described, or possibly a long sheet of bristol board wound round the bundle and held in place with the tape, may be necessary.

The steel strap has, I feel, contributed an important bit to modern factory management. It has enabled the manufacturer to improve handling efficiency, to make quicker deliveries, and to lower his costs of handling and shipping. It has meant, in the final analysis, a better product, more attractively presented, more speedily sent to its destination, and offered to the ultimate user at a more attractive price.

Employee Representation Plans Still Flourish

PLANS of employee representation by which groups of company employees bargain collectively with company management have not been discontinued to any appreciable extent as a result of the Wagner Labor Relations Act.

This conclusion is drawn from a recent nation-wide investigation of industrial relations policies by the National Industrial Conference Board. The survey covered 2,452 business establishments in manufacturing, mining, transportation and communication, wholesale and retail trade, finance, and public utilities. Employment represented by these companies totals over 4½ million, or 15.5 per cent of all persons gainfully employed.

Employee representation plans are in operation in 751 or about 30 per cent of the companies included in the Board's survey. These concerns employ nearly 60 per cent of all the workers covered.

In earlier Conference Board surveys relating to collective bargaining, substantially similar proportions of companies and employees were included in the employee representation group.

Organized labor unions have agreements affecting a portion or all of the employees in 287 of the companies covered in the investigation.

More Among Large Concerns

Large companies employ collective bargaining in some form more frequently than do small establishments. Among the companies in the survey employing 10,000 workers or more, 68 per cent have employee representation; 38 per cent, trade union agreements. Of the concerns employing less than 100 workers, 12 per cent reported employee representation plans, 5 per cent trade unions.

Among manufacturing industries, iron and steel, automobile and rubber had the largest proportion of employee representation plans. Petroleum refining products and public utilities in the non-manufacturing group most frequently reported employee representation.

Labor union agreements were more numerous in the clothing, printing and publishing, and stone, clay, and glass products industries in the manufacturing groups. Transportation and communication, and mining lead the non-manufacturing industries in the number of labor union agreements reported.

The Conference Board's investigation indicates that both employee representation plans and trade union agreements are most numerous in the Middle Atlantic and in the East North Central states.

Depreciation Dollars

Are so often baloney dollars that, even in the best of times, industry does not make replacements as fast as it ought to

★

WILLIAM LUCIUS CHURCHILL
Vice-President, The John R. Hall Corporation
New York

MY FIRST article (February, page 69) pointed out the serious effects of neglecting to treat depreciation of buildings as a reality. Those effects, however, are not confined to buildings. Walk through almost any long-established plant that uses a considerable amount of mechanical equipment. Your guide apologizes for certain units as being old-fashioned or obsolete. He explains that they intend to replace these units with modern devices "when we can afford it."

Obviously, if the management of these plants had actually put aside the depreciation reserves that bookkeeping records will disclose as having been charged to costs, there would be no question of affording to buy new equipment for replacement of the depreciated values.

Let's Look at the Record

A recent survey to determine the amount of primary machine units in service and needing replacement discloses that $20,000,000,000 of business is being withheld from machinery builders by the owners of these obsolete, out-moded, and antiquated machines.

Total value of all machinery (exclusive of transportation units) manufactured in the United States in 1929 was slightly more than $7,000,000,000. It is quite apparent, therefore, that replacement of depreciated machinery is only partially observed even during our most prosperous business periods. It is also evident that we need to manufacture machinery at a vastly greater rate than has prevailed—at least since the World War period—in order to replace machinery and equipment that have been charged off as fully depreciated.

Bear in mind that the $7,000,000,000 of machinery produced in 1929 included new and additional machinery as well as machinery needed to replace depreciated equipment. *The $20,000,000,000 shortage refers only to machinery needed to replace outworn equipment.* It would take us several years to catch up even if we were to double the 1929 record, when more than a million workers were employed in the production of machinery.

In view of the definite advantages to the owners of depreciable assets and to the material progress of society, it is astonishing to find so few enterprises that recognize and utilize depreciation reserves as an instrument for insuring their perpetuation, development, and growth.

Depreciation was specifically ordered to be excluded from costs in several of the NRA codes. The effect was to sanction dissipation of assets by permitting goods to be sold at prices that failed to provide for the replacement of equipment depreciation.

What Can We Use for Money?

Prior to the introduction of income taxes it was quite common practice to charge depreciation only when profits were good. Even today many of our financial reports state earnings "before depreciation," apparently endeavoring to indicate that profits are really better than the figures show. Technically they might as well state "earnings before paying wages" or "before paying for materials," because depreciation is just as positive an element of costs.

In efforts to enforce NRA codes, many curious interpretations of the purpose and need of depreciation in minimum prices were encountered. One case typical of the fallacious reasoning of many relates to a large manufacturing printing establishment. The code authorities attempted to enforce a rule including a uniform rate of depreciation in costs and hence in minimum prices.

The head of the printing concern protested vigorously against being compelled to include such machinery depreciation in his costs. He contended that practically all his machinery was so old that it had been entirely charged off in his depreciation account and that he could therefore produce more cheaply than competitors of shorter existence. The sales manager, however, told another story; their machinery was so old and out-of-date that their costs were higher and quality was lower than their competitors'.

"Why don't you buy more modern equipment?" the general manager was asked. His answer was: "What can we use for money? We're solvent but we're broke. Besides, if we buy new machinery, our costs will go up because we shall have the charge for depreciation." It is this type of reasoning, or lack of reasoning, that helps to retard progress.

★

Why did the depression last so long? Because the capital goods manufacturers were flat and industry's depreciation reserves were mostly bookkeeping figures that wouldn't buy plant and equipment. Failure to set aside those reserves in actual cash and then using the cash for replacements only, is tantamount to including a brick or two out of the building with each order sold

★

Federal income taxes are assessed against full earnings without deductions for depreciation after buildings and machinery have been depreciated down to salvage value. This fact would seem to imply that concerns that fail to replace de-

(Continued in advertising page 42)

Organizing for Recovery

3. WHEN A COMPANY GOES OUTSIDE FOR ITS EXECUTIVES

★

Consider now the trust that might have welded five capable organizations into one, but did not — chose instead to look for world-beaters

★

FREDERICK A. SMITH
President, Miller, Franklin, Bassett & Company
New York

LAST MONTH we considered the "one-man" industrial organization as a guide in the necessary building up of depression-weakened operating forces to meet the competitive demands of the future. The findings were not favorable.

Now let us look at another common conception of the correct way to build up a strong executive manufacturing force in any industry and see what it has to offer. This is the "outside talent" method.

Under this system, a constant lookout is maintained by the directing genius of the establishment for new ability outside his own organization. When such ability is thought to be discovered, it is immediately hired and placed in an appropriate position in the home plant, often over the heads of employees long awaiting promotion. The new talent may be embodied in any one from a president to a foreman.

Few manufacturing bodies escape this kind of reform in a greater or lesser degree. There is always a good argument for it: "We need new blood. Inbreeding leads to deterioration." Or there is an obvious need to weaken competition by hiring its best brains away from it: "So-and-so is a born inventor; we must have him at any cost." Or perhaps he is a born organizer. In any case, *"We must have him."*

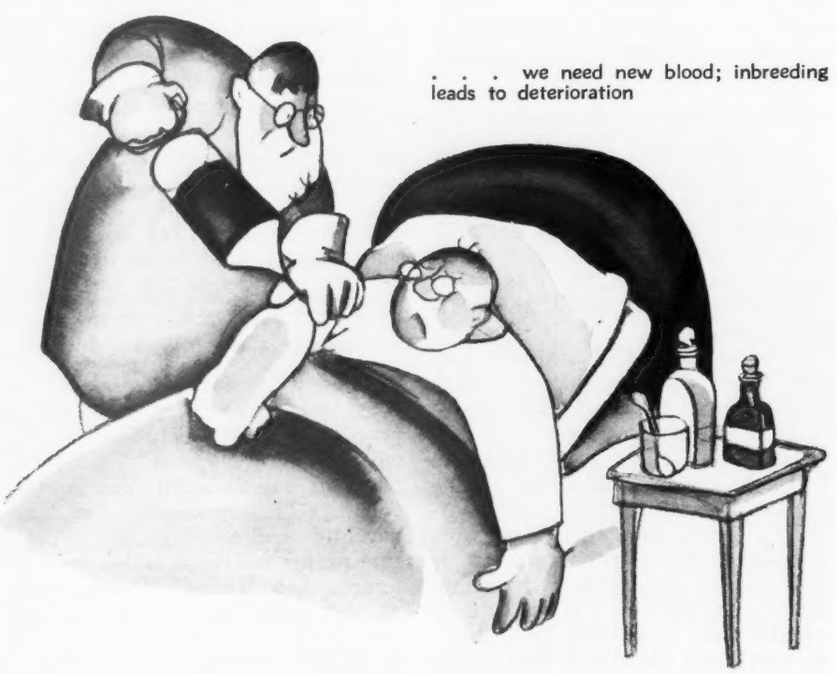
Out of Five, One

So we get him and try to fit him into the veteran organization with more or less success. What happens as a result of such efforts to absorb strength from the outside can best be illustrated by an actual example, drawn from the same wearing apparel industry in which the one-man firm, used to point the argument of our last article, is engaged.

The manufacturing process in this industry requires expert knowledge of special preparatory and finishing operations together with all kinds of shrinking, washing, dyeing, and drying. The product is made in a wide variety of qualities and is sold at an equally wide variety of prices.

The corporation we have in mind is popularly known in the trade as the "Trust." It is an amalgamation of five companies, brought about not by any inclination of each concern to be absorbed but by the forceful leadership of the head of one of them, who had ambitious designs to control the entire industry. By persuasion, coercion, and opportunism, he finally brought about a competitive situation that made it more desirable for the heads of the other four companies to cast their lot in with his combine than to stay out of it. So five complete, capable, and independent organizations were merged into one.

Now anyone who has been through such a merger knows how difficult it is to absorb the existing talent into the new organization. What is to be done with the five presidents, sales managers, and works managers, the 10 superintendents, and the 30 foremen to keep them all



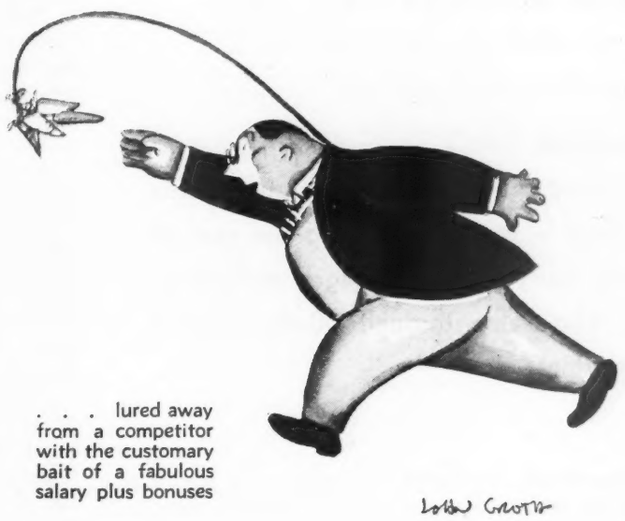
. . . we need new blood; inbreeding leads to deterioration

satisfied and still maintain anything like an over-all plant efficiency?

That would be a difficult job with the best of good will, yet what did our amalgamators do but ignore the talent they had and scour abroad to find an even superior brand to direct the destinies of their already complicated organization.

Sound manufacturing economics, not to mention good business sense, should have indicated that the best way to build up an amalgamated organization of several companies is to retain the best features of each. That is exactly what they did not do. With a perfectly competent array of trained men within their own ranks, ripe for promotion, the top executives looked abroad for "world-beaters" to fill first the important executive positions and then the lesser ones.

They lured a sales manager away from a competitor with the customary bait of a fabulous salary plus bonuses. Then they went after the works manager of another competitor on the same basis and got him. Finally they secured a general manager with a fine record for administration in a totally dissimilar industry. They had to make him a vice-president and give him a stock interest, but they felt he was worth it.



. . . lured away from a competitor with the customary bait of a fabulous salary plus bonuses

Later on they extended the same procedure to secure superintendents, engineers, and even such minor technicians as master dyers. This was not particularly difficult. All they had to do was to offer the man more money and over he came. Now this would have been a perfectly logical way to build up a strong organization if one had not already existed. For the matter of that, there were five strong organizations.

Enter the Villain of the Piece

For a time all seemed to go well. The new man took hold with vigor. Clashes of authority were few as long as the five original plants were operated as independent establishments. The new general manager, a stickler for efficiency, did not approve of this arrangement. It meant five local overheads, decentralized control, different methods of administration, too much surplus stock to be carried, and endless correspondence, phone calls, and executive travel. Besides, there was the constant vexation of allocating orders. There were, as he saw it, no compensating advantages. So he began to urge upon the directing heads, with his customary energy, the reduction of these plants to specialized manufacturing units under centralized direction and control.

In all of which he was acting in accordance with correct manufacturing principles—if there had not been the human element to consider. Somewhat to his discomforture, his colleagues who had retained the direction of the plants they had once owned, offered the most determined opposition, despite the fact that his plan promised them greater returns on their interests in the corporation.

However, the president backed his general manager, and the reorganization of the plants into manufacturing units began. Now the full force of the outside-talent plan began to make itself felt with a vengeance. Naturally, the general manager was obliged to disband the independent sales, accounting, and operating forces. Naturally, too, he put his own men in charge. They in turn made replacements down the line of foremen and minor executives.

The result was as might have been anticipated. Discouragement approaching demoralization spread through the ranks of the workers and the lower foremen. Starting with a what's-the-use attitude and passing through the phases of resentment and of efforts to find employment elsewhere, the morale of the plants has finally relaxed to a state of complete let-down. Nobody works any harder than is necessary just to hold the job.

Meantime the higher-ups' troubles have been thickening. Some of the world-beaters engaged from the outside have fallen down either because they had been overrated and were not big enough for their jobs or could not, in the nature of things, command the essential support of their subordinates.

Finally the principals, who formerly owned the four absorbed plants, became alarmed at the attack on their independence and have withdrawn into their shells, from which they oppose any and all changes on the general theory that they are aimed at themselves.

Decline and Fall

The effect of this state of affairs upon the Trust's business may easily be imagined. The volume is only half that done by all the subsidiaries before absorption, allowing for the state of business generally. The sales policy is indecisive, because the men who really have ideas are afraid to express them. Meanwhile the business of one of the largest independents is slowly creeping up on the Trust's and may overtake it, unless one of the several able men now maneuvering for control succeeds in getting it.

Our conclusion from this and other notable examples must be that the outside-talent method of building up an organization incurs a considerable risk of breaking it down. It does not always turn out that way, to be sure. Sometimes we must be prepared to go outside our own organizations for men for high or even low positions, rather than promote some mediocrity. Then, too, it *is* necessary to introduce new ideas and new viewpoints from time to time, but it must be done with the utmost discretion.

The outside-talent way, it would seem, has its very limited place in our plan of strengthening run-down organizations.

•IN APRIL—

how the trust's competitor built up from the inside . . . as you will guess at once, this is the right way to get organized for recovery

Pays 2499 to 1

Briggs Handicap Safety Sweepstakes comes to successful close. All-time plant safety records broken. Real winners were 99.96 per cent of the workers, many of them engaged on hazardous jobs, who came through 60-day period without accident

★

CORTLAND G. SMITH
Assistant Editor

PLANT operating men who have run out of safety ideas and are looking for new ones that work, could do worse than follow the example of the Briggs Manufacturing Company, Detroit, where on last October 8 five plants began a 60-day race for safety. Full details of that race were given in November *Factory*—in an article contributed by Henry J. Roesch, director of industrial relations at that concern.

Actually there were three horse races. Miniature races, of course. One was at the main plant on Mack Avenue with thirteen horses in the field, one for each division. Another was at the Highland Park plant with eleven horses. The third was an interplant affair with fifteen horses representing as many divisions in three smaller plants.

Rules were simple. Principal one was that for each lost-time accident a division's horse stood still on the track for a day. Fair handicaps were figured out. Division heads acted as jockeys, and thus added to the fun.

Some idea of the interest aroused may be gained from a glance at the photograph. It shows a group of workers at the Mack Avenue plant gathered around the board during the lunch hour in order to find out where their divisions stood, and maybe to place a modest bet.

The races ended December 15 with the enviable record of fourteen divisions having operated the entire 60 days without an accident. In Mr. Roesch's opinion this safety contest has done more to set employees to thinking about safe plant practices than any other medium of accident prevention ever before tried by his company.

There was excitement a-plenty in the Highland Park race, for example, when two jockeys spurred their mounts down the home stretch and crossed the finish line neck and neck. The more credit is due to the heads of these two divisions because of the hazardous nature of the work in which the men are engaged. One is the maintenance division; the other, the plant traffic and labor department.

At Mack Avenue the winner was Jockey Jeroy, who heads up Division 11. Again all credit is due this department because of the hazards attending peak production on punch press, welding, grinding, and metal-finishing operations. In this department several hundred men are employed on three shifts.

Perhaps the most exciting finish of all, however, was in the interplant race, where all three of the Hamtramck jockeys and five out of the six Meldrum entries crossed the finish line together.

First races are over. More are coming. Employees are demanding another contest. The bar will be lifted on March 1.

Not a Kick in a Shift

Everyone gets a break with this schedule. It works as well for a whole department as for a single job. No odd shifts, no relief man, 56 hours off after five days on the same shift. Each man knows his hours five months ahead

★

R. M. BRINEY
Assistant Superintendent
Electro Metallurgical Company, Alloy, W. Va.

"CONTINUOUS process" is the term used to describe those industries that operate 24 hours a day; but to those who actually man such plants, "shift work" is more truly descriptive. In a world whose business, educational, recreational, and religious activities are set up on a daylight-work, week-end-off basis, it is little wonder that many men find shift work unpleasant and irksome. Result: high labor turnover and diminished efficiency.

Natural and inevitable causes for complaint, common to shift work, are often aggravated by the type of working schedule in use. Some abortive schedules are the result of thoughtlessness; others are caused by adoption of arbitrary standards inadequate for shift work.

In day work, it is a comparatively simple matter to conform to weekly hours of 30, 35, or 40, but in shift work, the fact that the calendar week consists of seven days of 24 hours each for a total of 168 hours, rather complicates the easy magic of the "fives."

Many of the most common sources of complaint can be eliminated if certain principles are considered in drawing up a shift schedule:

(1) Each individual should receive equal portions of day, afternoon, and night tricks.

(2) Quick returns, double shifts, and 12-hour change-overs should not be regularly scheduled.

(3) Days off occurring between change from one trick to another should not be broken up, but should run consecutively.

(4) Days off should change over a period of time so that each individual has his share of free Saturdays and Sundays.

(5) Schedule should be repetitive so that it may be posted in advance for long periods.

(6) Number of hours worked per pay period should be as nearly uniform as possible.

In specific cases it may be necessary to disregard one principle in order to observe the others, but the greater number of these principles considered, the more satisfactory will be the schedule.

EIGHT-HOUR SHIFT SCHEDULE

Four Men — 42 Hours per Week — Twenty Weeks

12-8	8-4	4-12	Jan.	Feb.	Mar.	Apr.	May
A	B	C	1 21	10	2 22	11	1
A	B	D	2 22	11	3 23	12	2
A	B	D	3 23	12	4 24	13	3
A	C	D	4 24	13	5 25	14	4
A	C	D	5 25	14	6 26	15	5
B	C	D	6 26	15	7 27	16	6
B	C	A	7 27	16	8 28	17	7
B	C	A	8 28	17	9 29	18	8
B	D	A	9 29	18	10 30	19	9
B	D	A	10 30	19	11 31	20	10
C	D	A	11 31	20	12	1 21	11
C	D	B	12	1 21	13	2 22	12
C	D	B	13	2 22	14	3 23	13
C	A	B	14	3 23	15	4 24	14
C	A	B	15	4 24	16	5 25	15
D	A	B	16	5 25	17	6 26	16
D	A	C	17	6 26	18	7 27	17
D	A	C	18	7 27	19	8 28	18
D	B	C	19	8 28	20	9 29	19
D	B	C	20	9	21	10 30	20

Cycle Repeats Every 20 Days

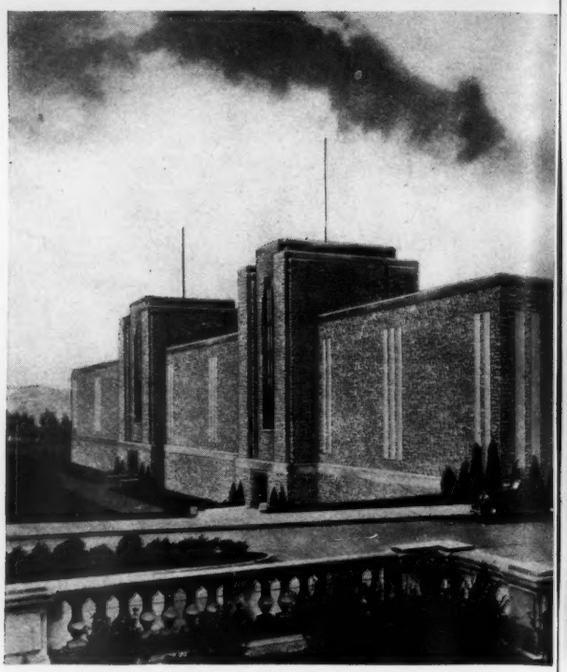
The schedule shown here can be used for a single job or for a whole department. Four individuals, A, B, C, and D, work in turn through the following cycle every twenty days: five night shifts, off 56 hours, five afternoon shifts, off 56 hours, five day shifts, off 56 hours. The cycle then repeats.

Because the cycle consists of twenty days, one less than a full three weeks, the men actually work six tricks in some calendar weeks. These six-day weeks work out as five in twenty; therefore the average hours worked per week over a 20-week interval is forty-two.

Besides being more acceptable to the men, this schedule eliminates the "relief man." Each shift job requires four men; each works regularly on the same task. There is no need to schedule a relief man for a number of unlike jobs.

No Windows and Why

LEWIS K. URQUHART
Associate Editor



Why build a windowless plant? And if you did, would the people who'd have to work in it like it? Factory sent an editor to look over the new Hershey office and printing plant. Here are his impressions plus some of the details of building construction, controlled lighting, and air conditioning systems

★

FIRST question that entered my head when I walked into Hershey's new windowless office building was: "Do the people who work in it like it?" Frankly I wasn't so sure. I thought of my own window on the twenty-ninth floor and wondered how I'd like it if I couldn't watch the Normandie dock any more. Suppose I didn't even know what the weather was doing? How would I like that?

Long before I left two hours later I had arrived at my own answer. I realized that fine views buy no breakfasts. It's nice to know they're there, but how many times of late had I watched the Normandie dock? As for Chocolate Avenue, Hershey, Pa., which is what you'd see from the windows of this new building, if it had windows, it's admirable enough in its small-town way, but who'd care to sit and look at a constant stream of motor cars all day long?

I was perfectly convinced, in short, that I'd give up my lofty view of the Hudson any day for desk room in this windowless, glareless, draftless, air-conditioned building. My reasons for coming to this fairly hasty conclusion will become apparent as we get on with our story.

Second question naturally was: "Why did they do it?" I remembered another windowless plant that had been built some years before, but had never actually been put into operation. The depression, people said. True, I had some faint recollection of a small windowless factory office building up in Connecticut that seems to have worked out satisfactorily. But weren't the Hershey people taking chances?

Cheaper to Build

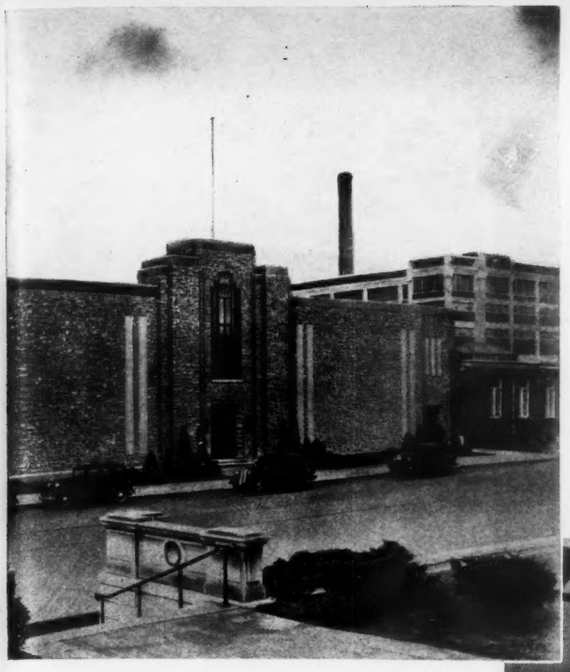
Apparently not. In the first place, Hershey had decided upon air conditioning. As might be expected of chocolate manufacturers, they were completely sold on air conditioning for comfort. What is good for processes must certainly be good for people, and all that sort of thing. And if you're going to put up an air-conditioned building, it should be self-evident that one without windows is easier to maintain—certainly no acres of glass to keep clean—and cheaper to operate. Actually, it's cheaper to build, too. Look at its long unbroken walls, and think of all the windows and awnings and shades there might have been. You won't need a slide rule to find the answer.

Really our story could stop right here with the indisputable fact that this was the most economical type of structure Hershey could have chosen. Add the fact that the windowless building can be as deep as you please. There is no question as to the need for daylighting in those areas that are farthest away from the windows. There is absolutely no choice so far as location of offices goes. One is exactly as good as another. Incidentally, that is a more important consideration than it would appear to be at first sight, as anyone knows who has ever been through this sort of thing.

The building is 151 feet wide, 350 deep. Consists of basement and three stories above ground. Exterior is native limestone. Hollow tile separated from the stone walls by a 3-in. air space completely lines the building. Fireproof construction, of course. Vaults, one on each floor, are protected by an automatic system that smothers incipient fires with a blanket of carbon dioxide gas.

Office and Factory

Any impression that this is only an office building should be hastily corrected. Hershey does all its own printing and it's a large order. Of a total of 205,260 sq.ft. of floor space, 48,471 sq.ft. will be given over to the printing department; 62,816 sq.ft. is office space; 35,774 sq.ft. is devoted to locker rooms accommodating all of Hershey's 3,000 factory employees.



THINK OF ALL the windows that will never have to be cleaned in the Hershey Chocolate Corporation's windowless office and printing plant. You who are about to build will do well to consider this type of construction. A comparable structure of conventional design would cost more to build and more to operate

LIGHTING is semi-indirect, a pleasing combination of Mazda and mercury vapor. It assures 20 foot-candles at desk level all of the time. Conditioned air provides comfortable working conditions winter and summer

Balance is used for air-conditioning equipment and other equipment and purposes.

Incidentally, front and rear sections of the building, housing offices and printing departments, respectively, are isolated from each other to prevent transmission of vibration.

Our description must, however, be confined to the office part of the structure, since the printing department is still under construction.

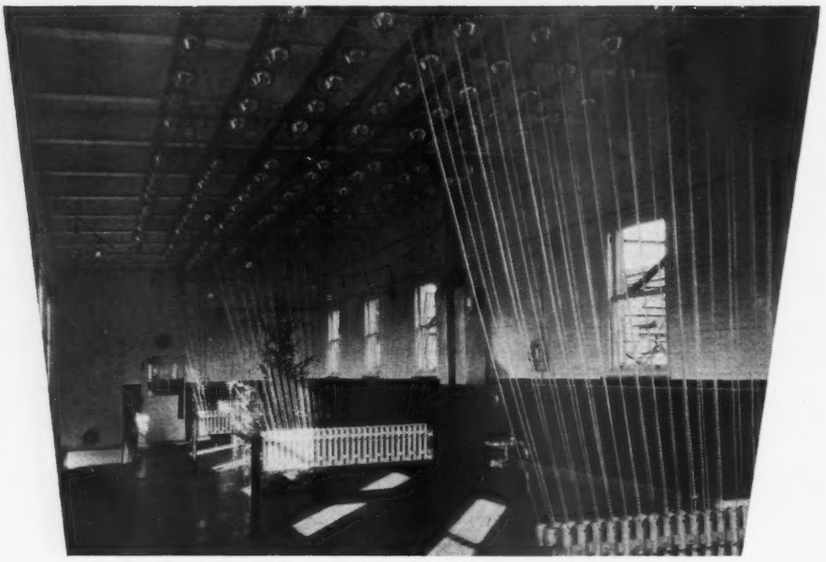
20 Foot-Candles

Shall we begin with lighting? Naturally, it is one of the most important considerations in this type of building. Fixtures are of the semi-indirect type. Wattage per unit is 1,050, of which 750 is Mazda and 300 mercury vapor. Spacing varies with room requirements. Lighting intensities at desk level average right around 20 foot-candles. The combination of Mazda and mercury vapor, incidentally, gives a very pleasing effect that borders on the spectrum of true sunlight. Seems the mercury vapor adds violet and blue to Mazda's orange and red.

Lighting, in other words, is completely under control. Exactly the same at quitting time as when the starting whistle blew—a condition quite unknown to those of us who depend on daylighting plus an admixture of artificial light as needed. How often have you suddenly discovered along about four-thirty that you've been spoiling your eyes for the past hour or more? Well, that can't happen in this building.

Ceilings are surfaced with cork

(Continued on advertising page 49)



HIGH AND DRY are mill men's clothes at Bethlehem Steel. These lockerless lockers and the wash room below are in the new six-room service building through which the men pass to and from work at the Merchant Mills. Showers, toilets, and washfountains in an air-conditioned room add to comfort

for

In and Out

A GLANCE AT the Christmas tree in one of the photographs on this page will fix the date when Bethlehem Steel Company turned over a new service building to employees of the Merchant Mills, Lehigh Division, Bethlehem, Pa.

Built to accommodate 977 men in three-shift spreads, this two-story brick and steel reinforced building incloses slightly more than a third of an acre, is divided into three spacious rooms per floor. At the front of the building is the clock room through which employees gain entrance to this section of the plant. Two other rooms on this floor are assigned to mill men. Because of the heavy shoes and other protective trappings they must wear, they are restricted as a safety measure from using the stairways. These two rooms are each equipped with eight individual showers, two of the latest type 54-in. wash fountains, and individual clothes baskets suspended on chains.

No Confusion

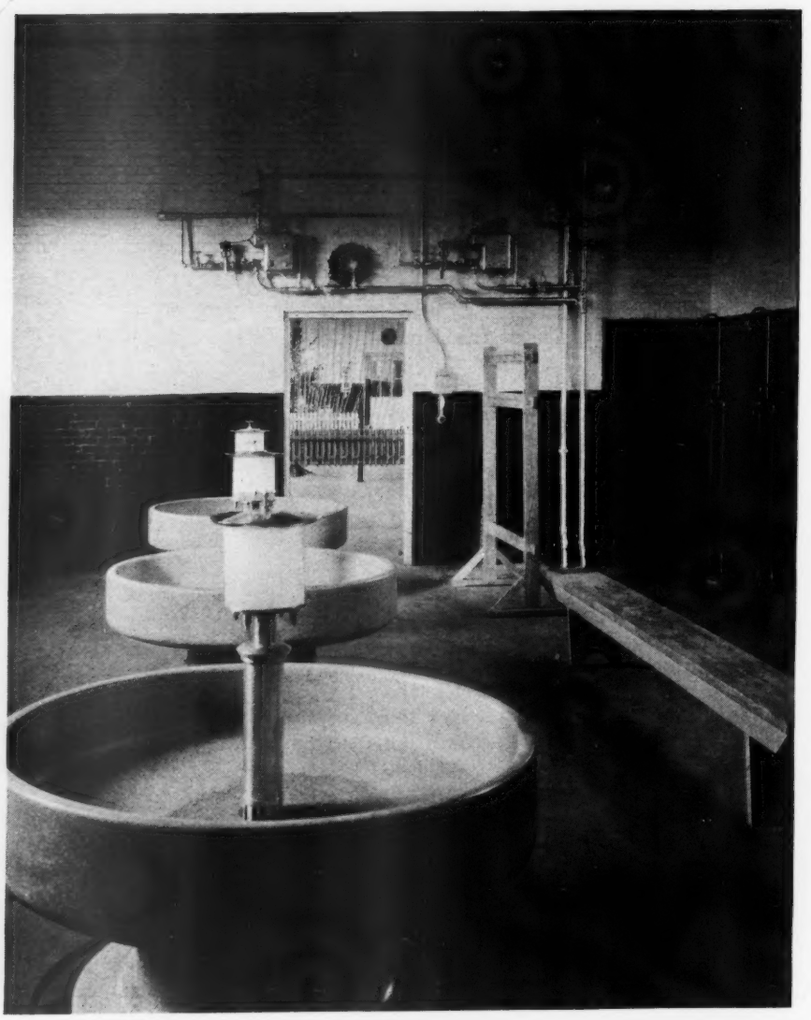
Of the second-floor rooms, one is for chippers, one for grinders, and the other for maintenance men. In these three rooms there are eighteen individual showers, five wash fountains, and the usual toilet facilities. The purpose behind the divisions by class of work is to prevent confusion during a change of shifts.

Steam heat is provided within the building and distributed through separate heat diffusers of a type that can be used in summer as air-conditioning units. Also, each room is provided with the necessary forced-draft ventilators and draft shields to protect men while under showers.

Water at Right Temperature

An outstanding feature is the method employed in heating the water used in the showers and wash fountains. As water is drawn in either wash fountain or shower, a sufficient amount of live steam is injected into the system to bring and keep the running water at a predetermined temperature.

Walls and ceilings are painted white, with black trim to the level of the windows. Each change of shift includes a janitor per floor who exercises supervision over the use of these quarters, and also washes floors and takes care of washroom equipment at the end of the shift.



The Human Factor in Maintenance

★ PART ONE ★

FREDERIC OAKHILL
Plant Engineer, Bauer & Black
Chicago

★

NUMEROUS articles have been written on plant maintenance, organization, and methods. Few have discussed the psychological and philosophical aspects of this work. Yet even in so prosaic a field as plant maintenance, a little reflection will show that the same principles of management and of dealing with people are the key to economy and successful operation as in any other field of management. Plant maintenance, although almost its sole function is to make it possible for other departments to operate to best advantage, determines the effectiveness of such a large investment in equipment and presents so many and such varied problems that it merits the attention, study and sympathetic understanding of the general executive as well as of the department heads immediately concerned.

Successful maintenance operations require consideration and coordination of at least the following factors:

1. Organization of the department.
2. Personnel make-up of the department.
3. Correlation of maintenance with other factory operations.
4. Procedures and methods.
5. Establishment of a logical program for housekeeping and preventive maintenance.
6. Routine work schedules.
7. Planning and scheduling major work.
8. Budgeting work and expenses.
9. Cost control of work.
10. Purchase and stocking of materials.
11. Work done by contract with outside concerns.
12. Tools and equipment.
13. Replacement of inefficient and obsolete equipment.

When you organize the maintenance department, don't forget that it's made up of men who have to deal with men. The same management principles that work everywhere else in the plant work here, too. They are the key to economical operation

A rapid review of these factors, with examples of their application, will show the importance of psychological and policy considerations in their successful performance.

1. Organization

In a functionalized, scientifically managed enterprise the relations of the individual departments to one another and their internal organizations are most carefully considered and arranged. It is the general rule, applicable as well in maintenance as in other organized activities, that the degree of authority and responsibility should be determined only after the study of each phase of the work. In maintenance, this rule means the breaking down of the general responsibility of the plant engineer, for the physical well-being of the plant, into the specific responsibilities of the department heads.

The use of charts helps to analyze these assignments clearly. These charts should specifically define each individual's responsibility and his relation to the scheme of things. The charts for individual jobs can then be combined into crew or department charts, and so on until the functions of the entire organization are shown. The relative value of the several functions can only be approximately shown by charts. But this by no means lessens their usefulness as a control and coordinating instrument of management.

The psychological reaction of an individual when he has been given definite responsibilities is most wholesome, for there is then no tendency to "let George do it." Most men respond to responsibilities definitely assigned and take pride in living up to them. This is particularly true when the man is allowed some leeway in the exercise of his own judgment.

In the process of organizing the maintenance department, one should refrain from overburdening key men with routine duties that consume all or most of their time. Instead, the routine work should be delegated to the men best adapted to it and, if necessary, additional individuals should be hired. The reaction of the creative worker to an overload of detail is marked; his thinking tends to be restricted and narrowed to a point where his best efforts are lost.

After the department organization has been worked out, all goes well if the several groups are arranged to function smoothly at their own tasks; yet the management must be flexible enough to allow for handling the unusual jobs that are bound to occur. One method of accomplishing this is to build the crews to a size where the man-hours of labor are just sufficient to do the day's work

economically, with one crew helping another now and then. Unusual jobs are then cared for either by adding more men to the regular crews or by having the work done on contract. If this arrangement is to work, the entire personnel must function as a team; "grandstanding" by one individual or crew will wreck any plan.

2. Personnel Make-Up

Someone once said, "It takes all kinds of people to make a world." This is true of a maintenance department. Much can be saved and a smoothly running organization can be developed if care is taken in selecting the men to make up the department. The difference between men is but little, though this little makes the difference; to the executive goes the task of evaluating this difference in order to place each individual in the scheme of things correctly.

The psychological make-up of individuals varies; and this variation determines whether the individual fits into the organization or whether the organization must be varied to suit the individual and his abilities.

Most small companies are handicapped in the quality of personnel they can afford to hire; even the large companies may find it difficult to secure men with abilities and comprehension broad enough to match the responsibilities of the job.

Men in key positions should possess a broad viewpoint combined with the qualities of manager, teacher, and leader. The mental reaction on the part of the worker to such a superior is most wholesome; it brings out the best in a man.

The chief electrician who fully appreciates what things are most important in his work trains his men to accomplish their tasks with as little inconvenience as possible to the departments serviced. The men in this crew will be working for the "boss," constantly on the lookout to initiate money-saving ideas. This attitude is the result of creating conditions that make for harmony of motive and action in a crew.

A master mechanic who can take a pile of raw materials and build it into a complex machine is a real asset to any company. But if this man does not have this same ability to make his department function effectively as a unit in the organization machine, his value to the company is lost. Again, the master mechanic who would seek to build the machine by his own efforts instead of giving his men a chance to exercise and demonstrate their abilities, would cause a double loss, for himself and the company. First, he would not be using his workers to full advantage; second, he would be tying himself up with trifles and routine work. Under these conditions, results are not difficult to predict. The number of jobs handled over a period of time will be small, the work will not flow smoothly through the shop, and the men will fear to express any ideas of their own.

A plant engineer, like others who occupy responsible positions, is looked to for instructions, counsel, and decisions. Decisiveness and straight thinking on the part of the executive bolster the confidence of the subordinate. The supervisor has the right to modify his plans, but it is dangerous when he attempts to change things without recognizing fully the effect of the changes. Nothing can more quickly wreck the morale of a working force than uncertainty as to what the "boss" wants, fear that he will not be pleased, that he may want something different, or that it may take a year and a day to get approval of the work and orders to start the job. The employee should not have to ask, "Shall we do it, do you approve this method, and when may we start the job?" This situation has disastrous psychological consequences. The men will always be waiting for the boss for fear of being reprimanded should they use their own judgment. Everything will be more or less timed with the boss's ability to get around to the particular job to give his opinion.

This condition tends to build up a "What's the use" attitude in the minds of the men; when asked for their opinions of the company they may retort with "I just work here."

The immediate superior may not be at fault, for the weakness of any executive is felt far down the line. The best method seems to be to delegate authority within the limits of the individual's task, to define clearly the results desired, hold him fully responsible for the final results, and leave him free to work out the details. Meanwhile, a helping hand will be lent when asked, sufficient supervisory checks will be made to be certain that all's well, but as long as the man is measuring up he will be kept free of hampering interference.

3. Correlation with Other Departments

The maintenance men are the doctors for industrial mechanical ills. Their worth is determined by the service they give other departments. In turn, the efficiency with which they can serve these departments is directly dependent on the help and cooperation they receive from other departments upon which they depend.

For example, if the machinists, while making a repair, overlook weak or partly damaged parts and return the machine to work in poor condition, the blame may rest with the production men who wanted the repair in a hurry and "rode" the machinists so that they did not have time to do a good job. Yet the production men are likely to let the maintenance department know in no uncertain terms what they think of them, regardless of whose was the fault, when the inevitable next breakdown occurs.

Again, a delay may be due to the fact that the storeroom has let itself run out of needed repair parts, or that the purchasing department has been slow in securing them. In either case, valuable production time is lost, the department is likely to be unjustly blamed, and compliments are exchanged that do not improve the harmony between departments. The more specifically responsibilities can be defined between departments and performance checked, the fewer the possibilities that any group may be placed in an unfair position.

To remedy such situations, each group should know clearly its own responsibilities and the coordination of its border-line activities with those of other groups. Common understanding can be fostered when one group fully appreciates the requirements of the others.

★

PART TWO, scheduled for April publication, concludes Mr. Oakhill's discussion of the psychological and philosophical aspects of the plant maintenance function, considering these factors—

Procedures and Methods

Housekeeping and Preventive Maintenance

Routine Work Schedules

Planning Major Work

Budgeting

Cost Control

Purchasing and Stocking of Materials

Work Done by Contract

Tools and Equipment

Replacement of Equipment

Gold in the Water You Waste

It's possible to get a little gold out of sea water, but there is lots more in the water that many plants waste—and it is much easier to recover. That means measuring. And measuring means meters

J. D. RELYEA
Superintendent of Manufacturing
Maxwells, Limited, St. Marys, Ontario

SOONER or later the plant engineer is called upon to answer the question "What can we do to reduce this large water bill?" If the plant is large or happens to be an exceptionally well-equipped small one, it probably is well piped and metered, and the answer to the question can be found quickly. In most plants, however, the engineer must contend with an installation that is far from ideal. He must use his resourcefulness to plan and carry out measurements.

Attention logically focuses upon departments using the largest amount of water. The compressor room is a good place to start, for almost all compressors are water-cooled and use considerable quantities of water. Here we usually find a water line piped to each jacket, the outflow running into an open funnel and then dropping by gravity into the drain.

In many installations the amount of water fed through the jacket is determined by the whim or habit of the operating man. Any old turn of the valve wheel and away she goes. Obviously, the first step here is to determine the minimum amount of water that will cool the compressor. If the water is kept just warm to the touch, it is approximately right. For accurate work the flow should be controlled so that the water comes out at the temperature recommended by the manufacturer. A thermometer should be used to check it.

With the minimum amount of water determined, we are still faced with the fact that a considerable amount of water is going down the drain. It is not so large as might be imagined, but still it is waste. Next step is to determine just how much water is going to waste in this way.

Although the amount may be calculated theoretically, the safest way is to put a hose on the outlet, run the water into a barrel for a given period of time, and then weigh it. Actual results of a test of this kind made on a battery of three compressors showed these wastes:

No. 1 48 gal. per hr., or 110,240 gal. per yr.

No. 2 36 gal. per hr., or 75,790 gal. per yr.

No. 3 33 gal. per hr., or 82,680 gal. per yr.

At 20c. per 1,000 gal. these wasted quantities would cost $22.05, $15.15, and $16.60, respectively.

What use can be found for this water? In the case mentioned above it was found that the water could be easily piped to a cold water wash tank near at hand. The tank happened to be at a lower level. In instances where the tanks are at the same level as the compressors, an overhead funnel can be used at the compressors, or the overflow can be piped straight through without funnel or valve.

Waste, Waste Everywhere

The plating department may be another large water consumer. In some plating departments steam for hot wash and plating tanks is led through two sets of coils at boiler pressure, then condensed in an open-end coil in a cold water tank. Condensation is accomplished by passage of a large, continuous stream of cold water which, along with the condensate, runs to waste in the drain. Notable savings can be made in such cases.

A similar condition can be found in the dip tanks of vitreous enamel departments. Quite properly the condensate is not returned to the boilers, but some form of improvised condenser is used, and thousands of gallons of water, plus many B.t.u.'s,

(Continued on advertising page 46)

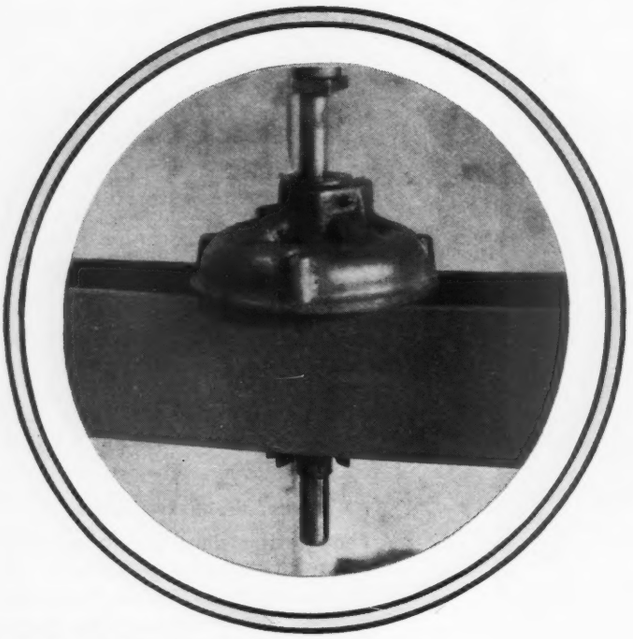
. . . if you suspect a department of wasting water, put on a meter, say nothing, and bill it for water actually used. You'll get results the next month

Induction Motor Maintenance

2. SLEEVE BEARINGS

LIONEL A. HUNT
Service Engineer
Bepco Canada Limited, Toronto, Canada

★



WHEN PRESSING out of the endbell a shaft whose bearing has seized, protect the end of the shaft with a copper block

FOR BETTER SERVICE FROM SLEEVE BEARINGS

1. **Find the reasons for every bearing failure**
2. **Make sure the journal is in proper condition before installing a new bearing**
3. **Keep oil rings clear when pressing out bearing shells from endbells**
4. **Never put back damaged or bent oil rings; install new ones**
5. **When pouring babbitt, have everything hot and dry**
6. **Turn babbitt bearings at high speed, using a sharp tool with good clearance**
7. **Don't make motor bearings fit too snugly**

NEXT TO sliprings and brushes, discussed in the previous article in the February issue, bearings occupy the most important place in the inspection and maintenance of induction motors and generators. Sleeve bearings of anti-friction metals such as babbitt are probably the most widely used, followed by bronze and similar alloys. On present-day motors ball and roller bearings are frequently used. These types will be treated in a succeeding article.

On the inspection form illustrated in the preceding article columns were shown for recording airgap measurements. At each monthly inspection steel feeler gages should be inserted between the rotor and stator at the top, bottom, and both sides. The smallest clearance should be recorded on the form. The airgap should not be allowed to become less than 0.010 in. without replacing the bearings; nor should the gap at one location ever reach a smaller value than one-half of the gap measurement diametrically opposite, for electrical as well as mechanical reasons.

It is unsafe to assume that the airgap when the machine is running will be as great as when measured with the rotor stationary, since "pulling over" is likely to occur with a reduced airgap. The result may be serious damage to the core and windings. It is essential to watch the monthly report forms and replace worn bearings before it is too late.

When a bearing fails there is a reason for it. Theoretically, there should be no wear in a well-designed, properly lubricated bearing, because the journal rotates on a film of oil and does not touch the metal of the bearing itself. With some motors when a low voltage is applied through a test lamp between the motor frame and shaft the lamp will not light, because of this insulating film of oil. For this reason a stator should never be tested for grounds with one test lead on the shaft.

There's a Reason Why

The fact that bearings do fail causes many mechanics to take such occurrences as a matter of course and simply install new bearings, without asking any questions. When a bearing wears out, burns out, or seizes, the reason should be found. It is usually due to foreign matter in the oil, unsuitable oil, bearing overload caused by excessive belt tension and so on, wrongly placed or plugged oil grooves, jammed oil rings, mechanical vibration due to a bent shaft, mechanical unbalance or improper gear meshing, and electrical unbalance.

It cannot be too strongly emphasized that every effort to seal housings and keep out foreign matter is well worth while. Although light, non-abrasive dust may not be directly harmful, it is non-lubricating and will tend to break down the oil film. This action will result in gradual wear. Foreign matter in the oil invariably results in wear.

Journals should be well polished before installing a new bearing, and if the bearing has failed through vibration or unbalance the journal should be turned or ground. The reason for this precaution is that quite frequently minute flats are de-

veloped on the journal which will wear the new bearing. It must be kept in mind, however, that every time a journal is reduced in diameter the bearing area is lessened, which results in greater loading per square inch; therefore, good judgment is needed when reducing shaft size.

If a bearing failure gives evidence of having been caused by too great a load, and the shaft is scored or worn, the journal should not be reduced in size but should be carefully built up by arc welding or metal spraying and refinished to size, or slightly oversize. When a shaft is refinished oversize it is sometimes possible to chuck the old bearings carefully and rebore them oversize.

Bearings sometimes fail from too great a load on the thrust area. Standard motor bearings are not designed to act as thrust bearings and if the drive puts undue pressure on the thrust areas, a suitable thrust plate or bearing should be installed. If the oil film breaks at the thrust area the bearing will heat up and probably seize the shaft.

When new bearings are being installed make sure that the rotor "floats" when running; this means that when the rotor is in its magnetic field it can be pushed toward either bearing by slight pressure on the end of the shaft. If the shaft shoulder strikes the bearing thrust before the rotor pulls into the center of the magnetic field there will either be a bumping noise or the bearing will warm up.

The cure for this noise or heat is to remove the bearing and skim enough metal off its thrust end to allow the rotor to move over.

With babbitt bearings the journal seldom receives the scoring and punishment which harder bearing metals sometimes give, and a seized babbitt bearing is easier to remove.

A rather surprising condition sometimes found with a babbitt bearing is that if considerable pounding takes place through the drive the steel journal may become seriously reduced in diameter, but the bearing will appear to be only slightly worn. Such drives are infrequent and bronze would probably be the better bearing metal to use. Generally speaking, however, genuine babbitt is a satisfactory bearing material.

Take Time to Do a Good Job

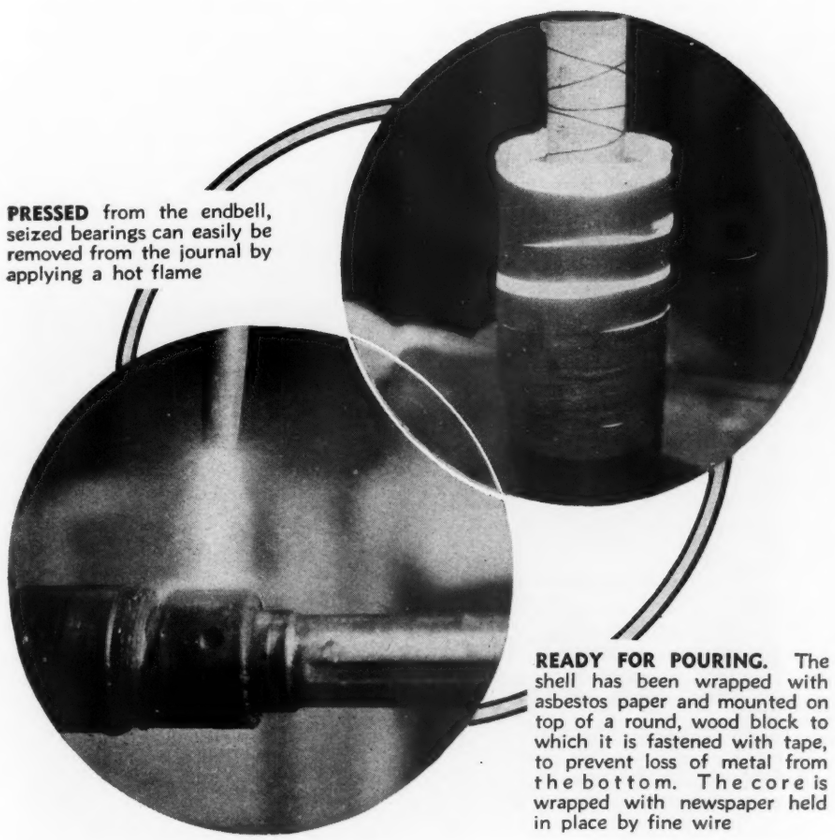
If the shell is steel with a babbitt liner the latter should be melted out, first taking care to measure how much the babbitt projects beyond the shell to form the thrust. If the original bearing is bronze the sleeve can be chucked and very roughly bored to at least $\frac{1}{4}$ in. larger inside diameter. The bore should be left very rough, a few anchor holes drilled in it (tinning is unnecessary), and this shell babbitted. Asbestos paper should be wrapped around the shell, a core of smaller diameter than the journal centered inside it, and the shell taped to a round block of its own diameter.

Heat shell and core to drive off all moisture before pouring the babbitt. The temperature of the babbitt should be checked with a pyrometer or, if none is available, the metal should be heated until it scorches a pine stick inserted in it. When it reaches the proper temperature it should be poured slowly.

After the bearing has cooled down the core can be driven out and the shell carefully chucked, trued up, and rebored to size. It is better to get the shell approximately true first and rough bore; then accurately true it and take fine finishing cuts.

For quick work on motor bearings a satisfactory fit may be secured by calipering the bore as follows: Adjust the inside calipers to the journal size; bore the bearing slightly larger than this setting, so that when one caliper leg is resting inside the bore the other leg swings free. Since the bore is larger than the caliper setting the free leg will strike the bore circumference in two places as it is swung from side to side; these two points should be $\frac{1}{8}$ in. apart for each inch of bore diameter. For example, with a 3-in. bore the free caliper leg should strike the bore in two spots approximately $\frac{3}{8}$ in. apart.

Oil grooves should be turned in each end of the bearing while it is chucked, and joined by two horizontal grooves passing below the ring slot. The horizontal grooves may be cut by turning the tool bit sidewise in the boring bar, engaging it with the babbitt, and operating the lathe carriage back and forth by hand, with the chuck stationary. Oil ring slots can frequently be cut out by chucking the shell $\frac{3}{8}$ in off-center and using a parting tool.



PRESSED from the endbell, seized bearings can easily be removed from the journal by applying a hot flame

READY FOR POURING. The shell has been wrapped with asbestos paper and mounted on top of a round, wood block to which it is fastened with tape, to prevent loss of metal from the bottom. The core is wrapped with newspaper held in place by fine wire

To Make Hot Bearings Run Cool

Sometimes it seems to be impossible to get a bearing to run cool, and at times one bearing after another will fail. In such cases it may be well to change to a special, absorbed oil with high film strength and lubricating value. In emergencies putting powdered graphite in the oil may save the day.

One generally overlooked reason for bearing failure is having a horizontal oil groove coincident with the load axis, so that as the journal rotates the oil is forced into the groove and the film breaks down.

Heating by Induction

Not new but continually finding new uses, this heating method will do things difficult or impossible by any other method. Here are some of the jobs it is doing

★

G. A. VAN BRUNT
Associate Editor

RECENT developments in inductive heating give promise of new methods and new possibilities that will mean much to various industries.

In the great majority of electric heating applications heat is produced either by passing current through some metal or material having comparatively high resistance, or by forming an arc between two electrodes. These methods of producing heat electrically are too well known to need comment.

Also, it has long been known that a piece of metal or conducting material can be heated by placing it inside a coil through which an alternating current is passed. Under the influence of the changing magnetic flux produced by the coil, heavy secondary currents are set up which are capable of raising the temperature of the metal to almost any degree. Several attempts were made over a long period of years to put this phenomenon to practical use, but it is less than 20 years ago that the Ajax Electrothermic Corporation developed the principles involved in inductive heating to the point where they could be applied to the melting of steel on a commercial scale. We are indebted to this company for the accompanying illustrations.

Absence of all fumes and products of combustion, along with the ease of control, has led to the wide adoption of this method of heating for producing fine steels, ferrous alloys of various kinds, and for melting brass, gold, platinum, and so on.

Modern inductively heated melting furnaces are essentially air-core transformers. The primary winding, which surrounds the melting pot, is a single-layer helix of water-cooled copper tubing, through which is passed a heavy, single-phase current at several hundred volts pressure and about 1,000 cycles frequency. Voltage, frequency, and current vary with the size of the furnace and various other factors.

Secondary Currents Do the Work

The metal to be melted constitutes the secondary of this transformer. Currents induced in the charge raise its temperature to the melting point, or as much higher as desired. Temperature can be controlled closely by regulating the power input.

Figure 1 shows induction furnaces for melting a high-resistance alloy. In Figure 2 are shown the circuit and component parts of a typical installation. As would be expected, the power factor of such a transformer is low and, depending on a number of different conditions, may range from below 10 to upwards of 60 per cent. Therefore, capacitors are introduced in the circuit to raise the power factor to unity.

In commercial installations the source of high frequency current depends largely on the capacity required. Furnaces of small capacity, below 50 kw., are usually supplied by a mercury arc oscillator. Such furnaces are used in melting precious metals and in producing small amounts of special steel or other alloys. Above 50-kw. capacity motor-generator sets are used.

Frequency varies over rather wide limits. Standard 60-cycle current has been used in some applications, although 960 cycles is practically the standard for most metal melting applications in which furnaces of considerable capacity are employed. For small-capacity outfits, say up to 50 lb., frequencies of 20,000 to 50,000 cycles are often used. In drying enamel, 360 cycles is used. Laboratory and experimental installations may use frequencies of 20,000 to 50,000 cycles.

There have been a considerable number of inductive heating applications in which the material to be heated is not a conductor. In such cases the container is made of iron, graphite, or a mixture of clay and graphite. It then serves as the secondary and the heat generated in it is transmitted to the liquid or material under treatment by convection and conduction.

Recently several other applications have been made that are quite different from those previously de-

FIGURE 1. These induction furnaces are used in making a nickel-chromium alloy

scribed. Probably the best known of these new applications is the drying of lacquered or enameled parts. The Chrysler Corporation, Detroit, has for some time been using this method of drying the enamel on wheels, radiator shells, lamps, tire covers, and other parts.

From the Inside Out

Since the metal parts themselves are heated inductively, the volatile solvents in the enamel or paint are first driven off from the bottom of the coating, with the result that a thicker coating can be applied without danger of wrinkling the finish. The drying process has been speeded up and high uniformity of baking secured, regardless of whether the parts are light or heavy, because all parts heat up at approximately the same rate. Figure 3 shows the entrance to the drying oven.

The oven consists essentially of a group of coils arranged so that the painted parts are passed through them on a conveyor. An average coil spans 3 or 4 ft. of the length of the oven, contains 20 or 30 turns, and carries 250 to 300 amp. These coils are excited from a polyphase circuit, instead of single phase, in order to produce a more widely varied direction of flux in the irregularly shaped parts. A frequency of 360 cycles is used, at 440 volts, three-phase. Capacitors are used to raise the power factor to nearly unity at no-load, which constitutes the most unfavorable condition on the system. The oven is largely self-regulating; when the parts pass out of the coils, the power input automatically decreases.

Heat treatment of razor blades is another recent application of inductive heating. This is a delicate operation. The steel, which is perforated, is in the form of long, thin strips and must be brought up to temperature as quickly as possible. Temperature control must be close and accurate.

Furnaces now used by one large manufacturer for treating blades are each 14½ ft. long and are divided into three temperature zones. Of the muffle type, they consist of a central core, which is in the shape of a partly flattened tube only $\frac{1}{16}$ in. thick, made of a heat-resistant, high-temperature alloy. This tube is insulated with $\frac{3}{4}$ in. of asbestos, around which is wound the water-cooled tube that serves as the primary winding. A frequency of 4,800 cycles, single-phase, is used.

It will be seen that the alloy tube constitutes the secondary and is heated. The strip steel is, therefore, heated by convection and radiation rather than directly by the magnetic flux, as in the applications considered previously. Temperature control is obtained by a device that is operated by the magnetic properties of the cold strip after it leaves the quenching blocks close to the furnace. Proper heat-treatment may require varying the temperature over a range of about 50 deg. F. The accuracy of the control and the low heat-storage capacity of the furnace permit raising or lowering the furnace temperature as much as 40 deg. F. a minute.

Another ingenious application of inductive heating solved for a manufacturer of crankshafts for trucks and buses the problem of heat-treating bearing surfaces without affecting other surfaces. Briefly, the process consists in heating inductively the entire area to be treated and quickly quenching with water under high pressure.

A high-frequency current of several thousand amperes is used, and in a few seconds it raises the surface temperature of the area to the desired value; then numerous jets of cold water are squirted onto the heated surface, chilling it almost instantly. The few seconds required to raise the temperature of the treated area does not give the heat opportunity to be conducted to the main mass of metal; therefore, the heating extends only a small fraction of an inch below the surface.

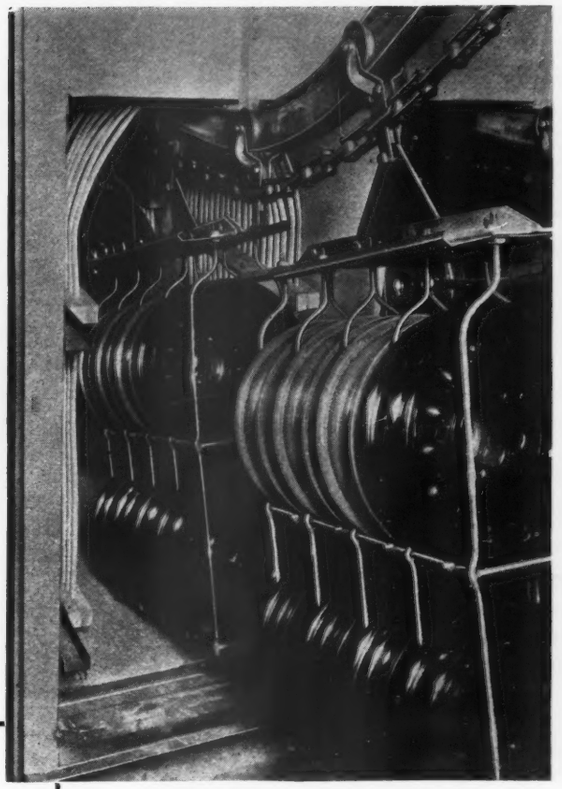


FIGURE 3. Freshly enameled wheels will come out the other end of this inductively heated drying oven with the finish hard and shiny. The coils can be seen just inside the entrance

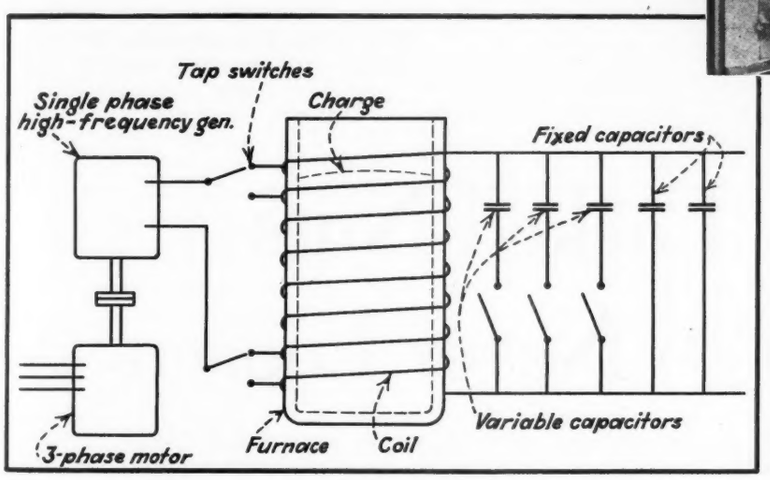
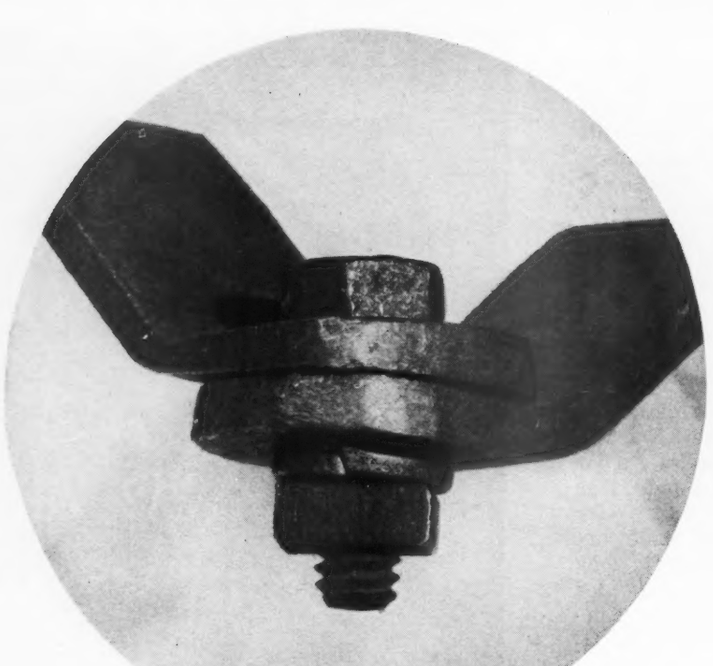


FIGURE 2. How the principal elements of an induction furnace installation are connected



Locked Nuts Never Loosen

Professors J. E. SCHOEN and H. A. FROMMELT
Marquette University, Milwaukee

★

TO HOLD a bolt-and-nut assembly tight, you must use in the assembly a washer that has a spring action. Contrary to common belief, it is not backing off of the nut by vibrational impulses that causes assemblies to become loose, but changes of dimensions in the assembly components. These changes remove pressure on the nut, make it possible for vibration to work the nut backwards.

A common form of spring washer is essentially a flat washer cut and bent to form the first ring of a helix. When compressed between the nut and surface of a bolted part, it tends to take up longitudinal changes in the assembly dimensions. By doing so it maintains stresses in the bolt and nut that are essential in keeping pressure between the threads.

Distinction must be drawn between the terms locked and tight. When a bolt and nut are assembled the nut can be turned down until tight, but this tightness may exist only momentarily. If the assembly is made secure, so that it will not loosen, it is locked; the tight condition becomes permanent.

Five factors tend to loosen bolt-and-nut assemblies before vibration can work the nut off:

1. Reduction of distance between bolt head and nut may result from natural wear of the parts. Friction between high spots on the surface will cause wear, reducing the thickness of the joint. The bolt head and nut are also subject to this wear. Reduction is in the order of only thousandths of an inch, but it is sufficient to loosen the assembly.

2. Increased distance between bolt head and nut can result if the assembly is subjected to a higher temperature than that at which it was originally stressed.

3. Permanent stretch takes place in the bolt if it is stressed beyond its elastic limit. This stretch can occur at the time of assembly or later, when movement of the parts increases elongation to the point where permanent set takes place. Undersized or improperly designed bolts may contribute to this difficulty. If the bolt is stressed to a point within the elastic limit, any slight increase in distance between bolt head and nut will be compensated for by the natural tendency of the bolt to return to its original dimensions.

4. Reduction of friction between the threads of the nut and those on the bolt may result from improper thread cutting or damage to threads during assembly. Vibration, in this instance, may bring stresses that will exceed this friction and cause the nut to back off.

5. Nuts, especially if they are small, may stretch laterally because of the compressive force exerted in tightening. This reduces the amount of thread surface contacting the thread surface on the bolt; therefore, reduction of friction occurs, making it possible for the nut to back off.

It is obvious that if loosening in bolted parts takes place initially as a result of changing dimensions, no locking device can perform its function unless it compensates for these changes. Loosening occurs only after these changes have taken place; to prevent it such changes must, in effect, be prevented.

The spring washer performs just this function. As pointed out above, its spring action compensates for dimensional changes and maintains stresses. To do this, the proper washer must be selected for each assembly. If it is undersize, it will flatten under the pressure exerted upon it and become an ordinary flat washer. It must be thick enough, or it will not perform its function. To overcome this difficulty, it is sometimes possible to use two of these washers, one under the nut and one under the bolt head.

This Motor or That?

Many different types of mechanical loads are imposed by equipment. Motors have widely different operating characteristics. Matching one against the other is the essence of correct application. It's not so very difficult to do when you know how — but you must know how

★

R. C. ALLEN
Engineering Division
Westinghouse Electric & Manufacturing Company
Philadelphia, Pa.

YEARS AGO when a motor was just a motor, and the drive was just a lineshaft, there were few problems involved in applying motors and control. Today motors are used for practically every type of drive, and controls are almost human. Aside from special types of motors and controls designed for and usually supplied with the machine which they drive, most industrial applications fall into fairly well-defined classes, for which so-called standard designs are available.

To select the correct motor for a drive, the starting and accelerating as well as normal operating characteristics and requirements of the driven equipment must be understood. Differences in the motors that can be selected for a particular drive are principally in the starting and accelerating characteristics.

If the type of motor required for a drive is not definitely apparent, check the following requirements of the driven equipment: (1) Starting or break-away torque; (2) Accelerating torque or characteristics; (3) Full-load torque, or speed and horsepower; (4) Load condition—constant, or adjustable speed, constant or variable torque.

Torque is the pull, usually expressed or considered as pounds pull at 1-foot radius, required to handle the load. The full-load horsepower (brake horsepower) and speed can usually be determined from the operating or load conditions, or by readings from a test motor.

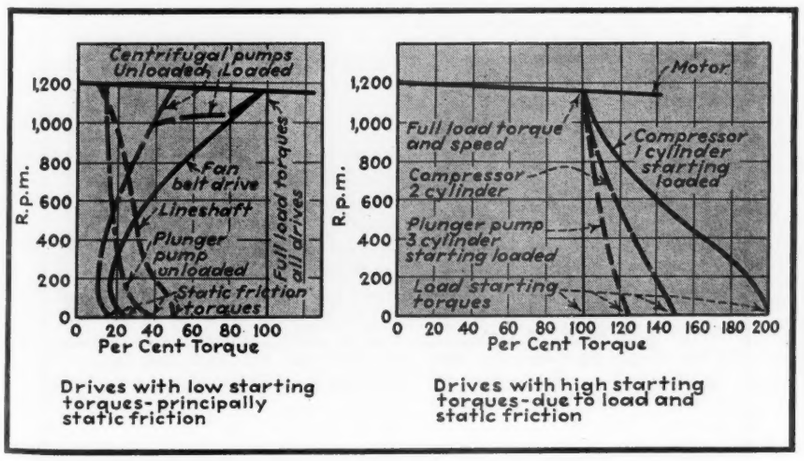
Motor torques are usually expressed as a percentage of the full-load torque.

Starting torque is the force required to overcome the static or break-away friction. It can frequently be determined by a lever arm (rope around the pulley) and spring scales or weights. The starting torque for the same drive varies greatly at different times due to frequency of start, lubrication, temperature, and so on. The worst possible condition should be considered as the break-away torque, and the starting torque developed should be in excess of this, not only for quick and positive action, but to allow for a possible torque reduction due to voltage drop.

Load torques during acceleration after bearings and other parts become free moving, are of fairly definite characteristics for different types of drives. Figure 1 shows a few typical accelerating torque curves. The torque delivered by the motor must be in excess of the load torque at all times or the unit will "hang" at that speed point.

For the purpose of selecting standard motors, driven loads can be divided into the general classes shown in the table.

FIGURE 1. Typical starting and accelerating speed-torque curves for various drives. Torque values shown, particularly for static friction, will vary in different installations



What Speed-Torque Curves Show

Types of drives commonly used need no extended comment here. Belts, chains, and so on increase the load-starting torque. Direct-coupled motors are usually best for high-speed drives, whereas for low-speed drives gear-motors give the most compact installation and require the least floor space.

A motor that is able to start a load usually has sufficient torque to accelerate it to full speed. When determining the correct motor to use it may be necessary to compare the motor starting and accelerating torques with those of the load. This is more frequently required with squirrel-cage and synchronous motors, since a variety of designs having specific characteristics is available.

Figure 2 shows the speed-torque curves of a squirrel-cage motor and a driven load, with the terminology employed. At the instant voltage is applied the motor starting torque is 140 per cent, point *A*, of the full-load torque, whereas the load static friction is *G*, or 25 per cent. The excess motor torque will start and

CLASSIFICATION OF MOTOR-DRIVEN LOADS

By Starting Torques

Light
(50% full load, or less)
- Fans and blowers
- Centrifugal Pumps
- Compressors (large) starting unloaded

Medium
(50-100% of full load)
- Lineshafts
- Compressors (small) starting light
- Reciprocating pumps, starting light

High
(100-200% of full load)
- Compressors, starting loaded
- Reciprocating pumps, starting loaded

By Load

Constant Speed
- Compressors
- Plunger pumps
- Lineshafts

Adjustable Speed
- Multi-step, many speeds
- Fans
- Multi-pole, limited number of speeds
- Fans

High Slip
- Punchpresses

High Torque
- Hoists
- Cranes

By Duty Cycle

Continuous
- Fans
- Pumps

Intermittent
- Hoists
- Cranes

Reversing
- Laundry washers
- Hoists

By Type of Drive

- Belts, flat or V-type
- Chains
- Gears
- Coupled, flexible or solid
- Geared motor-reducer

accelerate the load to *D*, or until the torques of the two are equal.

The accelerating torque is the torque available at any instant during acceleration for increasing the speed. The greater this excess torque, the quicker the unit is brought up to full speed.

The pull-in torque, *B*, is the minimum torque value of the speed-torque curve. It is not a well-defined point on the curve, but occurs before the motor reaches its operating speed. To guard against a design having an objectionably low point on the speed-torque curve, which might result in the motor failing to bring the load up to full speed, the National Electrical Manufacturers Association has set a minimum standard value of 110 per cent of full-load torque for most classes of squirrel-cage motors.

Voltage Drop Reduces Torque

For synchronous motors the pull-in torque has a somewhat different meaning. It is the torque developed when running at its maximum speed as an induction motor; that is, without excitation. It is from this slip speed that the motor must be synchronized or pulled into step by applying excitation. The pull-in torque is usually considered as the torque developed by the motor at 95 per cent speed, or 5 per cent slip.

Pull-out torque, *C*, is the maximum load torque that a motor will handle without stalling, or at least a very perceptible drop in speed. Excessively low voltage can reduce motor torque to such an extent that the load torque will equal the resulting pull-out torque, and the motor will be pulled out of step. Motors and controls are usually designed to permit a momentary voltage reduction of at least 20 per cent, without causing a pull-out.

Reduction in voltage results in more current being drawn from the line to produce the required torque. The resulting current will be in inverse proportion to the voltage change. Operating beyond full-load torque, except momentarily, imposes an overload that may cause excessive heating.

Slip Comes In

With d.c. motors peak loads are limited, not by a pull-out torque, but by the ability of the motor to handle the current satisfactorily from the standpoint of commutation and heating. Commutating poles are a great aid in eliminating injurious commutator sparking under high or fluctuating loads.

Rated induction motor torques, including synchronous motor starting torques, are reduced if the voltage is less than its rated value. The actual torques are in proportion to the square of the ratio between the voltage applied to the motor and its rated voltage. For example, if the motor starting torque is 140 per cent and the voltage is 80 per cent of normal, the resulting starting torque is 0.64 x 140 per cent, or only 90 per cent of the full-load value.

Slip, *F*, is the change in speed from no-load or synchronous speed to full load, expressed as a percentage of the no-load speed. The difference between the no-load and full-load speeds divided by the full-load speed and expressed in per cent, is termed the speed regulation of a motor. General-purpose induction motors usually have from 3 to 4 per cent slip. Shunt-wound d.c. motors have from 10 to 15 per cent whereas compound-wound motors have an even greater speed change, depending upon the amount of compounding. The actual full-load speed is not al-

(Continued on advertising page 52)

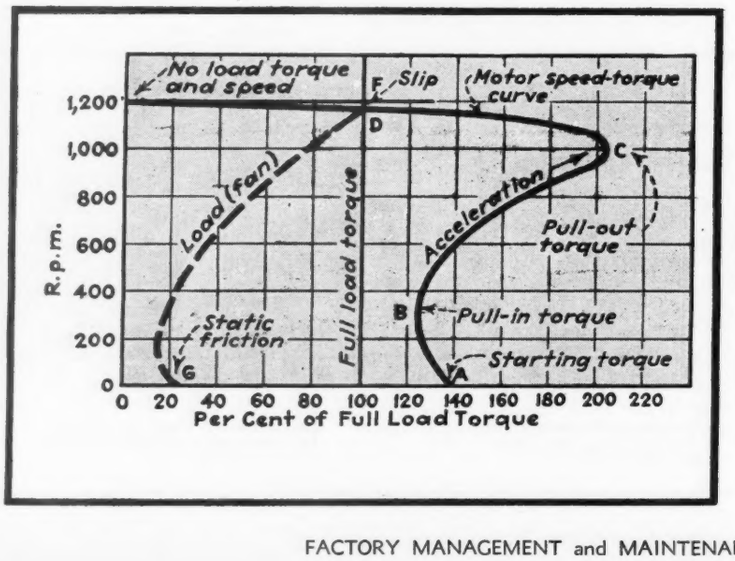


FIGURE 2. Terminology for squirrel-cage motor torques, and typical driven load. The excess of motor torque over load torque at any speed causes acceleration. Unless motor torque is in excess of the load, there will be no acceleration

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• HEAT GUN supplies instantaneous heat up to 400 deg. F. For controlled application of accurately concentrated heat to limited areas. (3601)

• WATER FILTER and purifier removes through one filtration turbidity, chlorine, and unpleasant tastes and odors. (3602)

• DIE CASTER, new, is specially designed for pressure-casting lead or zinc parts with inserts of other metals or materials. Handles multiple-cavity dies. (3603)

• "MAGIC GLASS" is really a light-polarizing cellulose-acetate material; possible applications include such things as sun glasses to reduce glare, windshields to tone down approaching headlights, color matching, polarizing microscopes, three-dimensional movies. (3604)

• MERCURY-VAPOR lamps, high-intensity type, are now available in 250-watt capacity, have average life of 2,000 hours, can be used satisfactorily in existing fixtures if enclosed. (3605)

• WOOD, fireproofed by a new process, can be worked easily, takes paint and varnish, actually stands as a barrier against fire and prevents its passage. (3606)

• ENGRAVING instrument, electric, portable, will write or mark permanently on metal surfaces of any hardness. (3607)

• ROBOTYPERS produce individually typed form letters at three times the speed of manual operation. One operator can run four. (3608)

• STRIPER, developed primarily for use in city streets, is useful in any plant where much floor striping is done. (3609)

• EVEN WRENCHES are attractively packaged these days. One concern puts six in a metal-edged box that's grease-proof, stainproof. (3610)

• SCREW DRIVER, automatic, costs half. Not reversible but used rigid for taking out screws. (3611)

• COST FINDING record book for conveyor belts helps you keep a running record of conveyor performance as a means of determining actual belt cost. It's free. (3612)

• LUBRICATION manual contains a store of vital information needed for effective maintenance of machinery. (3613)

• BALL BEARINGS—new manual is available without charge to executives and engineers responsible for bearing selection and maintenance; summarizes factors affecting selection, application, and operation; tabulates characteristics, dimensions, capacities. (3614)

• STAMP for permanent marking of metal parts is made of hardened tool steel, has set screws to regulate depth of stamping. (3615)

• CLEANER for metal parts prior to plating or enameling may be used in original powdered form for direct application, particularly for removing grease, or dissolved in water. (3616)

• PLATE GLASS now comes in colors—blue, green, and peach, to mention three that have already been accepted by architects as a new aid in design or decoration of buildings. (3617)

• IRON PAVING PLATES, primarily for highway use, are non-skid, wear-proof, more durable than other paving materials. Price compares favorably with brick, asphalt, etc. Why not for plant streets? (3618)

• PRECISION SCALE, inexpensive, is said to be accurate up to 1/100 gram, weighs up to 100 grams, operates without loose weights, is convenient to work with, easily moved about. (3619)

• DESK TRAY has wide-open spaces on all four sides for easy handling of papers, is made with tubular corners for stacking posts so that any desired multiple assembly may be made. (3620)

• AT LEAST one adding machine now comes in a molded plastic case. It's lighter, of course, than one of cast metal. (3621)

• DUST CONTROL—at nominal cost you can get four important discussions of industrial health hazards and employer responsibility. (3622)

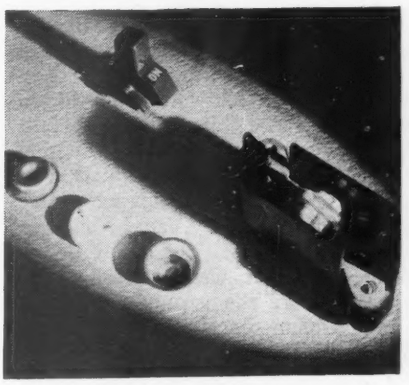
• FIVE-DAY WEEK is subject of a recent survey covering 2,452 business establishments. (3623)

• INKWELL BOTTLE sees to it that you don't smear fingers when filling your pen. There's a trick cone-shaped cup in the neck, which fills with ink when you invert the bottle and turn it back quickly. (3624)

• HARDENER—there's a new one said to produce inpenetrable concrete. (3625)

• FOREMAN IMPROVEMENT—you can get a new bibliography for a nickel. (3626)

• SAFETY PAPER, for checks, produces a trail of "void" constantly repeated wherever touched by ink eradicators. (3627)



NON-CLICKING SWITCH with mechanism no larger than four or five nickels stacked together, operates silently as contact is made or broken by liquid mercury. (3634)

• MACHINERY is revealed as a creator of jobs, not a destroyer, in a study of technological advancement reported in "Ten Facts on Technology and Employment." (3628)

• BOOTS, British, are seamless, resist the action of petrol, oil, and acids. (3629)

• ULTRA-VIOLET ray treatment is being used during winter months on workers in a candy factory—with definitely beneficial results. (3630)

• TIME RECORDER, new, is tamper-proof, lends itself to use of Continental time—1 to 24 o'clock with decimals for ease in computing payrolls. (3631)

• INCREASE in number of women workers during past 50 years was primarily, according to recent study, result of technological improvements which developed new type of work and increased demand for labor. (3632)

• REFLECTION FACTOR of colored paint may be approximated by comparison with color chips. (3633)

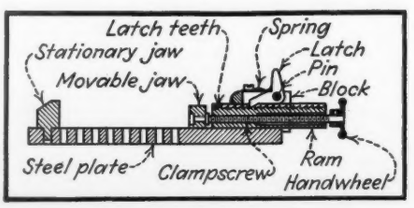
Operating Shorts

Wide-Range Vise Has Quick Adjustment

JOHN A. HONEGGER, *New York*

A vise that can quickly be adjusted over a wide range is shown in the illustration. It consists of a steel plate in which a series of tandem holes has been drilled to accommodate a stationary jaw. At the other end of the vise a block, machined to a snug fit for the ram, is screwed and doweled. The ram has a series of latch teeth cut into the upper surface.

A clearance hole for a clamp screw is drilled through the ram and tapped to the proper size for a portion of its length. A slot is cut in the block to accommodate the latch,



which is pinned in place and kept in contact with the ram teeth by a spring. To one end of the screw a movable jaw is fastened by a collar and pin. A handwheel is pinned to the other end. If desired, the wheel can be replaced with a crank.

In operation, the stationary jaw is set to the required distance, the work placed in the vise, and the ram pushed forward until it contacts the work; then a turn of the screw clamps it tight. To release the work, the screw is eased off, the latch is lifted with one hand and the ram pulled back with the other.

Ground Protection for Portable Loaders

T. G. ELLIS, *Toronto, Ont., Canada*

Recently two portable bucket loaders of the caterpillar type were installed for handling coke. They are driven by 220-volt, three-phase motors. Power is supplied from 550/220-volt transformers, which constitute an insulated circuit.

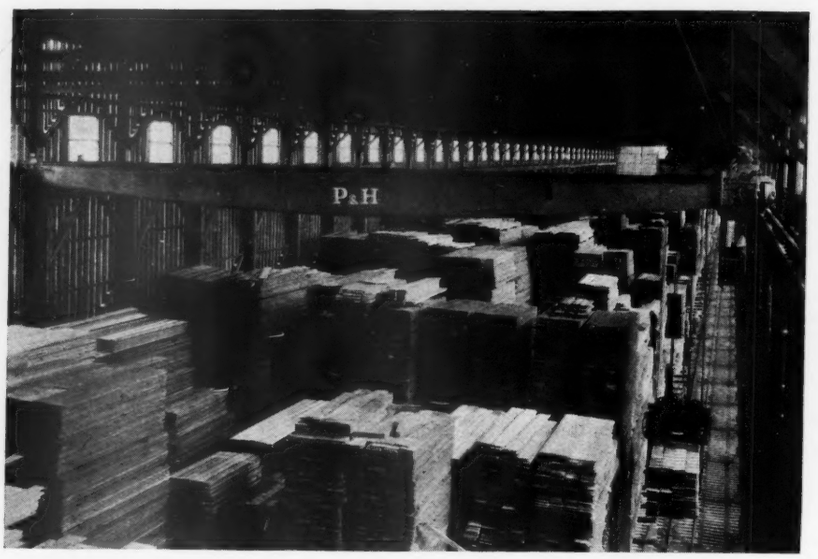
The frames of the loaders were grounded in the usual manner through the fourth conductor in the drag cable. It was realized, however, that if the ground conductor were broken or disconnected, and there was an insulation breakdown on the motor coils or other equipment, a shock hazard would exist; so the protective measures shown in the sketch were adopted.

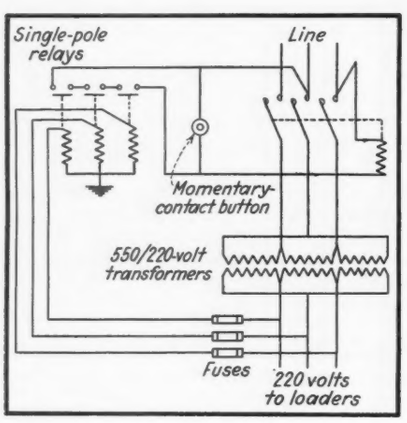
Three single-pole relays were connected in star across the transformer secondaries, and the star point grounded. The relay contacts were wired in series with the holding coil of a magnetic switch, with a push-button for resetting.

If a ground develops on either of the loaders one of the relays will open, causing the magnetic switch to open and disconnect the supply circuit. As soon as the trouble has been cleared pushing the button will reset the relays. It will be seen that this scheme also gives some protection against single-phase operation.

Of course, it is applicable only to an insulated circuit.

Mr. Ellis's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.

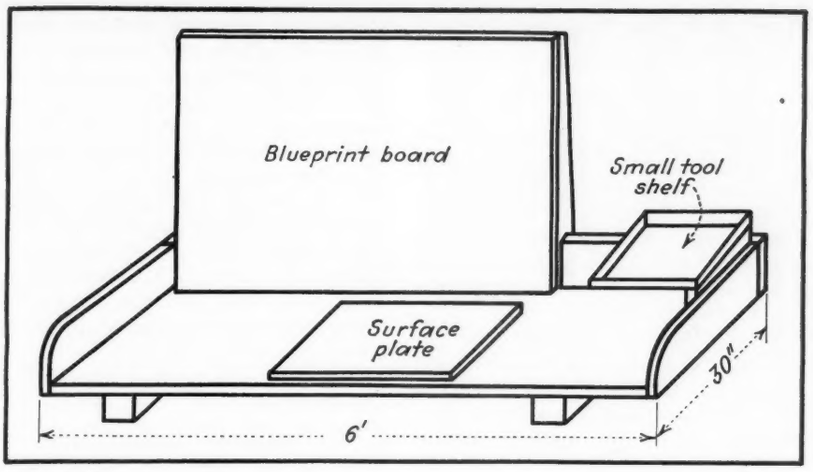




Telephones for Crane Cabs

SOURCE, *Harnischfeger Corporation Milwaukee*

Telephones installed in crane operators' cabs at the Weyerhaeuser Timber Company's plant in Tacoma, Washington, enabled shipping clerk to give loading instructions from his desk, regardless of where the crane was operating along its 1,000-ft. runway. Simple installation required only two extra trolley wires to complete telephone circuit connected with central switchboard.



Special Bench Makes for Efficient Inspection

IRA S. WILLIAMS
West Philadelphia, Pa.

A bench top, designed for inspection of small machined parts and assemblies in a metal-working plant, is readily adaptable for inspection in other industries.

Its features are a removable, blueprint-posting board of ¼-in. tempered Masonite and a tool shelf. The tool shelf offers a convenient place for the inspector to place his tools. The blueprint, when attached to the board, is always visible and out of the inspector's way. It is not constantly folded and unfolded until it becomes soiled and illegible and has to be replaced. This orderly arrangement adds to inspection efficiency.

Dimensions are arbitrary; this top was 6 feet long and 30 inches wide. Bench legs have been omitted, since standard bench legs are available in most plants. If desired these benches can be made portable by mounting them on trucks or skids.

Wise manufacturers are putting special guards in their plants nights, week-ends, and holidays as protection against fires. For, as plants get busier fire hazards increase. No reasonable precaution against fire is wasted.

Clean Brick Walls with Pumice, Soap, Ammonia

JOHN E. HYLER, *Peoria, Ill.*

Brick walls can be cleaned by sandblasting, but cases arise where a relatively small cleaning job is involved, and where it is not convenient for one reason or another to put a sandblaster on the job. In such instances a good cleaning compound can be applied.

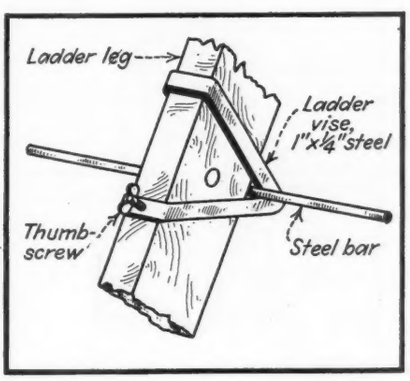
To do this, first go over the walls with a stiff wire brush and take off all soot and dirt that will brush off easily. Either a hand brush or a rotary wire brush that can be attached to a convenient portable power unit may be used. Then make up a compound in the proportions of 1 lb. of powdered pumice to a half-gallon of soft soap and a half-pint of aqua ammonia. Make sure that the materials are well mixed.

Apply this mixture with a brush, allow it to stand for 20 or 30 min. and then rub it well into the brick with a stiff brush. Finally, use a hose equipped with a spraying nozzle, or a compressed-air type of spray-cleaning gun, to rinse thoroughly the surface of the brickwork.

Ladder Vise for Cutting Bar Stock in Racks

H. MOORE
Hamilton, Ontario, Canada

Steel bars are usually stored in racks with the smaller sizes at top levels, to make handling easier. However, it is often difficult to drag out a bar, several feet from the floor, and saw off a piece. An easier way is to saw off the required amount without removing the bar from the rack.



For this purpose a vise of some kind is necessary and the one shown in the sketch is hard to beat for simplicity and effectiveness. It is made of flat steel, V-shaped, with both ends bent over to fit the ladder side. One end is tapped for a thumbscrew with a swivelled end, so that it will not cut into the ladder every time it is tightened.

The bar to be sawed is pulled out a little and tightened on the ladder by adjusting the thumb screw. When tight it holds ladder, vise, and bar firmly together, and the bar may be cut.

To Stop Oil Leakage from Gear Cases

A. E. WINDLE, *Plant Engineer*
Kroger Grocery & Baking Company
Cleveland

Reduction gear cases are not entirely filled with oil or grease; there is some air above the oil.

When heated by the gears and bearings, the air, sealed in by the oil or grease, expands and builds up a slight pressure which will eventually force the lubricant out through joints or around bearings. Such leakage may be troublesome in several ways. In any event it is wasteful.

Leakage from this source can be stopped by venting the gear casing. This can be done in some instances by drilling a small hole in a plug in the top of the gear case. Where possible to do so it is better, however, to use a short piece of pipe or tubing mounted vertically in the top of the casing and suitably screened or turned over in a reverse bend to prevent the entrance of foreign material.

Attempts to cure the trouble by the use of heavier lubricants will be futile. They may retard leakage, but will not stop it. In the meantime the bearings may not be properly lubricated.

When Residual Magnetism Makes Relays Stick

WALTER C. BACHMAN, *Nazareth, Pa.*

Residual magnetism in small a.c. relays is occasionally an annoying source of trouble. It develops gradually after a long period of service.

If a faulty relay appears to be mechanically and electrically in good

condition the presence of residual magnetism may be checked by opening the relay by hand with the current off. When the magnetic circuit is broken, all tendency to stick disappears until the magnet is again excited electrically.

The trouble is easily remedied by fastening a piece of brass shim stock or other very thin, non-magnetic material to the face of the core. Only a thin separator is necessary or desirable. Any appreciable gap in the magnetic circuit of a.c. magnets will result in a larger exciting current, which may cause overheating.

Residual magnetism in d.c. relays is much more common and may be similarly remedied. In this case, also, only a very thin separator is needed, although with d.c. relays the width of the air gap does not affect the current or the operating temperature of the coil.

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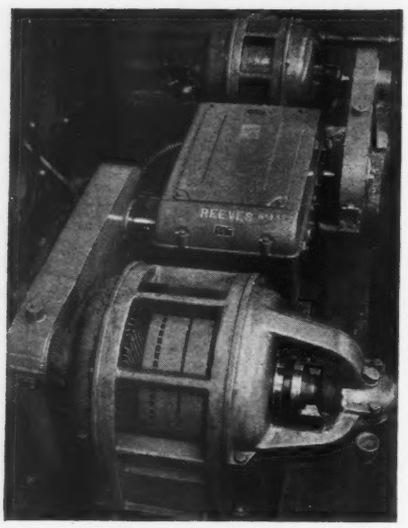


Variable-Speed Transmission Gives Different Frequencies

FRANCIS A. WESTBROOK
Consulting Engineer
Center Conway, N. H.

A simple, effective means of securing the different frequencies required for testing by a manufacturer of instruments is shown above.

It consists of a 60-cycle 1,200-r.p.m. synchronous motor connected through an inclosed chain drive to the constant-speed shaft of a variable-speed transmission. The variable-speed shaft of the transmission is in turn connected by another chain drive to an a.c. generator which is provided with a frequency indicator. By adjustment of the variable-speed transmission it is possible to obtain and hold any desired frequency between 20 and 70 cycles.

Float Switches Protect Slurry Pump Motors

JOHN H. GALLANT, *Montreal, Canada*

The diagram shows connections of a system of protection that has saved us considerable trouble and money.

We have two slurry basins about 20 ft. deep, with a pump pit 20 ft. deep, 25 ft. long, and 20 ft. wide, for each basin. Each pit contains two slurry pumps direct connected to 100-hp., 2,300-volt, 1,200-r.p.m. induction motors. These motors are controlled by oil circuit breakers with overload and low-voltage protection.

Only one pump in each pit is used at a time, the other being held as a spare. These pumps deliver the slurry to a trough 80 ft. above the bottom of the pits. Sometimes the casings of the pumps break, usually on the load or slurry-trough side of the pump. Formerly, if the attendant happened to be away, 4 or 5 ft. of slurry might collect in the pit before the valves could be closed.

The motor that was running at the time usually was burned out and the oil circuit breakers short-circuited. The slurry had to be cleaned out, the burned-out motor rewound, and the spare dried out before operation could be resumed. This meant long interruptions and expensive repairs.

To prevent such interruptions we installed two relays; one for each pit, two float switches, and a signal horn. The float switches are set so that 4 in. of slurry in the pit will close their contacts thus energizing coil *M* in the relay and pulling up the plunger, *P*. This action closes contacts *A-A*, which are normally open, and blows the horn to warn the attendant. He can then close the valves and stop the flow of slurry before it causes any damage.

At the same time contacts *B-B* and *C-C*, normally closed, are opened, thereby opening the circuits of the holding coils of the oil circuit breakers and stopping the motors. The flow of slurry is thus quickly stopped and burn-outs prevented in the event that the motors are wet from slurry splashing on them. The spare motor and pump can then be started at once, avoiding an expensive interruption.

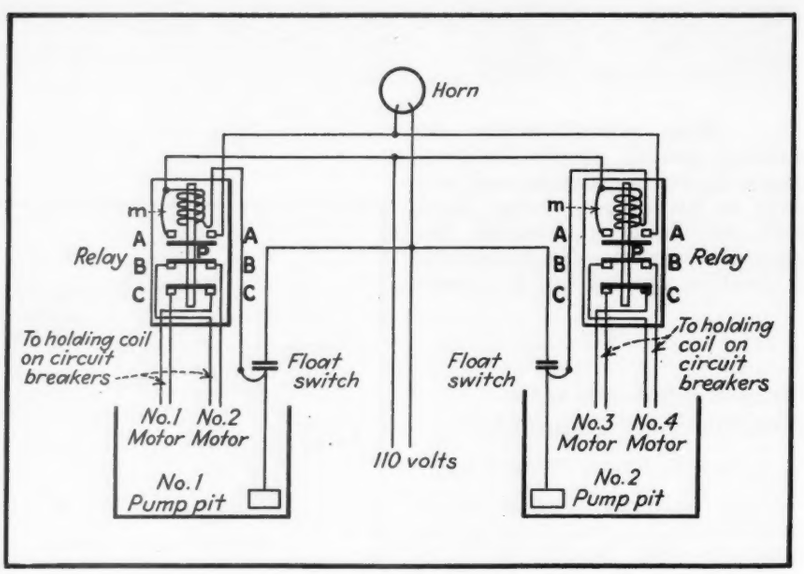
Owners' names may be marked on drafting tools easily and effectively as follows: Roughen surface with sandpaper; letter name with india ink; and, when ink is dry, cover with a thin coat of transparent varnish.

Low-Voltage Lamps Avoid Shock Hazard

J. M. MYERS, *Waynesboro, Va.*

Every year a few workmen are killed and others are severely injured when using 110-volt portable lamps inside boilers or tanks. Such accidents can be avoided by using low-voltage transformers and lamps.

In one plant two 50-watt lamps are used when the boilers are cleaned. So a 600-watt, 110/6-volt, single-phase transformer was obtained, together with a supply of 6-volt, 50-watt bulbs. The transformer was mounted on a piece of $\frac{1}{8}$-in. aluminum measuring 13x19 in. A standard three-wire, rubber-covered cord with a three-pole plug cap (locking type)



on one end was connected to the primary of the transformer. The third, or ground, wire was connected to the metal plate and to the transformer core. It connects to the conduit through the plug receptacle. This cord is sufficiently long to enable the transformer to be moved to the boiler manholes, but the size of the baseplate prevents it being taken into the boiler.

Two portable lamps are connected to the secondary of the transformer by rubber-covered, two-conductor cord, clamped to the baseplate.

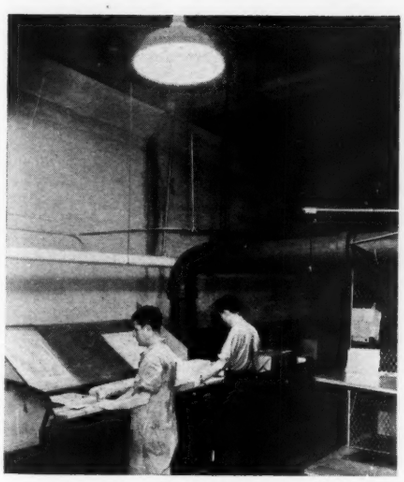
A sheet-metal cover made of 20-gage galvanized iron was fastened over the transformer to protect it. A handle for carrying the outfit was attached to the top of the cover.

•

Eyestrain Disappears Under Mercury Light

SOURCE, *Westinghouse Lamp Company Bloomfield, N. J.*

With the installation of mercury lighting, eyestrain took a permanent holiday from the sorting tables of the United Parcel Service, Inc., New York. High-intensity mercury lamps over the sorting tables give higher level of illumination and a bluish-green color which affords sharp contrasts. Illumination levels were increased 18 to 30 footcandles, with the result that parcel sorters no longer complain of eyestrain and headaches.



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For Sweating Pipes, Granulated Cork Insulation

MARK BELL, *Passaic, N. J.*

It is common practice to apply granulated cork to cold surfaces in order to prevent condensation. By using it on such items as circulating water lines, condenser water boxes, and pump casings condensation can be reduced to a minimum. Unless the application is correctly performed, however, labor and time will have been wasted.

The surface should first have a priming coat of red lead. Then the paint mixture for 100 gal. should be prepared in the following proportions:

Whiting, 735 lb.
Interior varnish, 65½ gal.
Raw linseed oil, 3½ gal.
Drier, 3½ gal.

Granulated cork of Nos. 8-12-mesh size should be applied freely. A good thick coating is desirable. When the special paint has dried, a finishing coat of lead and oil paint may be applied.

Do not apply the finishing coat with a spray gun. The cork will be more effective if left unpainted, but if a finishing coat is desired, apply it lightly with a brush. The gun gives too concentrated a coat to allow the cork to be fully active.

•

Preventing Absorption of Moisture by Brick Walls

W. E. STEWART, *Newark, N. J.*

Brick walls, when exposed to driving rain or heavy snow, often become sufficiently saturated to transfer moisture to the interior of the building where it may cause damage. When this occurred at the plant of an oil company the manager promptly applied a remedy that was efficacious and inexpensive.

A heavy-duty spray gun was made up from pipe fittings and a plunger-type valve, as the photograph shows. A discarded tin can, a connection to the compressed air line, and a thin mixture of cement and water completed the waterproofing outfit.

The cement mixture was composed of portland cement and water only, no sand being used. Water was added to the cement until the consistency was distinctly fluid, rather than mushy. The proportions were about one of cement to three of water. The essential requirement is to get a mixture that can be sprayed forcibly enough to give a certain amount of penetration. The finished coat, when dry, appears more like paint than a coat of cement.

After a long spell of fine weather had thoroughly dried the wall, it was sprayed with the cement mixture, using an air pressure of 90 lb. per sq.in.

After two long, wet winters this wall is still resistant to moisture and shows every sign of remaining so.

SPECIAL NOTICE. . . . $10 will be paid for the best Operating Short submitted during the month of March. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Questions & Answers

CONDUCTED BY

G. A. Van Brunt

How Fill Cracks in Wooden Beams?

Large cracks appear occasionally in the wooden beams of our plant buildings. They are unsightly and make us wonder whether they indicate structural weakness. If any readers have had similar experience it will be appreciated if they will explain what causes these cracks and tell us the best methods and materials to use for filling them, in order to prevent further deterioration and make them less conspicuous.

—R.F.

CRACKS or checks in wood beams are caused, fundamentally, by the drying out or "setting" of the wood fibers.

If the cracks do not extend the full length of the beam the best method of treatment is to drill ¼-in. holes, 1½ in. deep, at the beginning and end of each crack. Cut ¼-in. diameter soft wood dowels, 1⅝ in. long, dip in glue, and tap them into the drilled holes.

Then work a marine calking compound (No. 1 light, or the grade used above the water line) into the cracks. Immediately after the compound has been put in, press it a little below the surface of the beam with a round, pointed tool or rod. As the cracks open and close according to the weather conditions, the calking compound will automatically expand and contract without breaking away.

FREDERICK A. KISSNER
Ever Ready Label Corporation
New York

THESE cracks are probably caused by atmospheric conditions: that is, by exposure to air that is sometimes moist and sometimes dry. On damp days the wood absorbs moisture, which it loses in dry weather. This repeated expansion and contraction of the wood fibers causes what is commonly called weather checks. Checking is also noticeable in timber that has not been properly dried.

All such cracks tend to weaken the timber.

A good filler for such purposes is sold under the name of Plastic Wood. It should be tamped into the cracks with a very thin blade until they are completely filled. When dry it can be sanded or planed down and finished as desired.

On outdoor structures we use aluminum paint for protection. A year before applying the paint we give the timber two coats of creosote, which is applied hot and brushed in.

C. E. ROGERS,
East Angus, Que., Canada

Are Economic Lot Sizes Practical?

Your paper has published a number of articles telling how to determine by formula the economic lot size in which to order replenishments of materials and parts in stores. To what extent are these formulas actually used in practice? Are they practical?

NOT ALL factories make use of stock-limit control. Quite a few companies manufacture to regular production schedules, quotas, or budgets, producing at an average rate sufficient to fill orders either expected or actually received. In these cases the use of stock limits is only incidental.

In factories using stock-limit control, such as those which assemble a considerable variety of product from standard parts, stock limits are in the great majority of cases still set by judgment. However, a number of leading firms that have inventories large enough to run into considerable money now set their stock limits by the use of slide rules, logarithmic charts, or tables embodying the basic formula for lot size. (See special supplement Inventory Control, page S-82, in the August 1935 issue, for this formula and its application.)

The advantage of applying the formula may easily be demonstrated by working out a few examples, assuming that orders are placed weekly, monthly, every six months, or at other probable periods. Assuming or taking actual, costs for set-up or quantity price reductions, and assuming the usual carrying charge of 16 to 20 per cent, a substantial difference will be found in the unit costs for the different periods and sizes of lots. On an inventory of any size, the saving by using correct control quantities should pay many times over for the slight labor of computation.

(Continued on advertising page 60)

Answers Wanted

How Clean Oily Belts?

Some of our leather belts, single and double ply, and ranging from 3 to 10 in. wide, have become pretty well soaked with lubricating oil. I have always understood that this is bad for them. What is the best way of cleaning these belts? Probably they should be washed in gasoline. Is some other solvent better? Will they need any other treatment? How can one tell when cleaning in this way is necessary?

—P.L.R.

Maintenance Painting Practice

A study of maintenance painting practice in several plants covering such industries as textiles, heavy machinery, small machine tools, hosiery, and electrical appliances, showed that in 1933 the average yearly consumption of paint was 0.8 gal. per square foot of floor space. Again on the average, buildings are painted outside every 3½ years, and on the inside every 6 years. Office interiors are painted every 5 years.

We want to determine whether these figures are truly representative of industrial practice. It will be appreciated of readers will give us corresponding data for their plants.

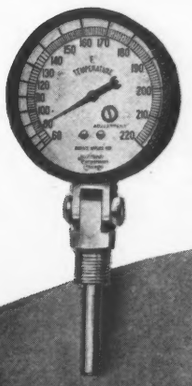
—J.F.A.

Increasing Speed and Horsepower of D.C. Motor

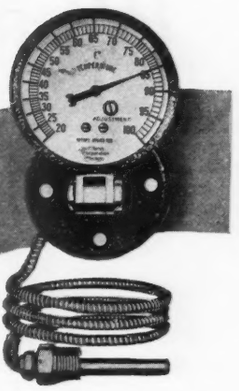
Is it possible to increase the horsepower output of a d.c. motor by rewinding it so as to increase the speed? For example, we have a 5-hp., 500 r.p.m., 230-volt, compound-wound motor which we want to speed up to 1,500 r.p.m., and raise the horsepower as much as possible. Can the speed of this motor be increased that much? If so, what would be the maximum horsepower that could be obtained?

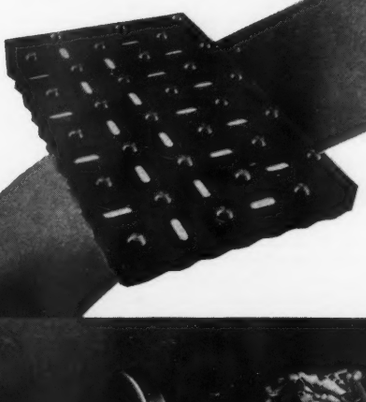
—H.S.

Flashes from the equipment makers

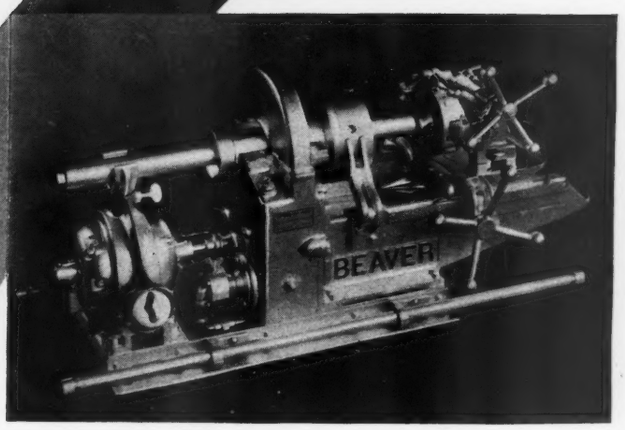


Universal socket dial thermometers. Jas. P Marsh Corporation, Chicago





Steel paving plates for protecting concrete floors. Bethlehem Steel Company, Bethlehem, Pa.

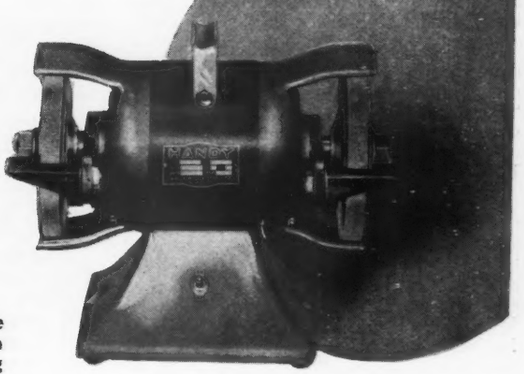


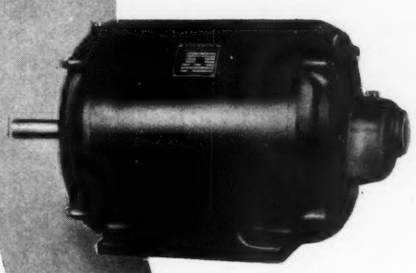
Vacu-Break safety switch. Bull Dog Electric Products Company, Detroit

Model-A Special pipe machine. Beaver Pipe Tools, Inc., Warren, Ohio

Protectit switch, with overload protection Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn

Type MM paint spray gun The Alexander Milburn Company, Baltimore





Type SR single-phase motor. The Emerson Electric Manufacturing Company, St. Louis

Six-inch Handy bench grinder Baldor Electric Company, Chicago

What's NEW in Equipment

Air Conditioning, Ventilating, Heating

Condensing Unit — Type WFB-33H. Hermetically sealed. Uses water as condensing medium and freon as refrigerant. Motor of ⅓ hp. direct-connected to a 2-cylinder compressor. Westinghouse Electric and Mfg. Co., East Pittsburgh.

Duct — Wire mesh covered with Zonolite mineral insulation, an insulation with low thermal and sound conductivity. Fireproof. Low resistance to air flow. Zonolite Corp., Fisher Bldg., Detroit.

Dust Collector—Wet collector towers. Six dust impingement plates. Seventh plate designed for use as water entrainment separator. Dirty-air baffle under first impingement plate. Screened strainer on sludge discharge line. Claude B. Schneible Co., 3951 Lawrence Ave., Chicago.

Filter - Blower Unit — Centrifugal blower and filter frames are contained in housing ranging 30-36 in. high, 30-48 in. wide. Motor sizes, ½-¾ hp. Capacities, 800-3,200 cu.ft. per min. Lau Heating Service, Inc., Fernwood Ave., Dayton, Ohio.

Heating Surface—Lightweight copper tube and fin heat transfer surface for fan-system heaters. Two steam-distributing tubes are contained in each regular condensing tube to give uniform temperature over entire heater face area. John J. Nesbitt, Inc., Holmesburg, Philadelphia.

Humidistat and Thermostat—For air conditioning systems. "Hytherstat" controls temperature and humidity. "Comfortrol" is same but has intergeared dials to give control in terms of effective temperature. Julien P. Friez & Sons, Inc., Baltimore.

Nozzle, Spray—For air conditioning applications. Operates without air pressure on water lines having pressure of 30 lb. or more. NS-10 gives diverging spray at orifice. NSS-11 directs thread of liquid against baffle plate. Rega Mfg. Co., Mount Hope Ave., Rochester, N. Y.

Building Materials

Waterproofing Material—"Fluresit." Mixed with water and applied in two coats by brush to inside surface of masonry. American Fluresit Co., Rockdale Ave., Cincinnati.

Electrical Control

Alternator Switch—Operates electric circuits alternately in installations employing duplicate devices. Master switch is intermediate to primary and secondary switches and does not carry current. Enterprise Foundry Corp., 2902 Nineteenth St., San Francisco.

Contactor—Size O, multiple magnetic contactor for use with small single-phase and polyphase a.c. motors, or as flexible relay for complicated control systems. Normally open or normally closed contacts, or combination of the two. General Electric Co., Schenectady, N. Y.

Switch—Safety. "Vacu-Break." Has specially designed arc-rupturing contacts contained in inclosed arcing chamber, designed to minimize presence of combustion-supporting gases. Three lines. Bull Dog Electric Products Co., Detroit.

Switch—Silent switch utilizing mercury-break principle. General Electric Co., Schenectady, N. Y.

Switch — Toggle switch with automatic current overload protection. Bimetallic strip upon becoming overheated causes circuit rupture. Rated: 250 volts, a.c. or d.c., 1.3-15.0 amp., 1 hp. Types B and BH, latter with heater elements. "Protectit." Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

Switches — Combination magnetic switches. Maximum ratings: 25 hp. at 220 volts, 50 hp. at 440 volts to 600 volts. Embodies hand-reset, air circuit breakers. General Electric Co., Schenectady, N. Y.

Switches—Line of combination magnetic switches with maximum ratings of 25 hp. at 220 volts, and 50 hp. at 440-600 volts. Air circuit breakers manually reset. General Electric Co., Schenectady, N. Y.

Switchgear—For light-duty service. Uses oil circuit breaker in either of two ratings: 600 amp. and 5,000 volts, or 800 amp. and 2,500 volts. Both will interrupt 25,000 kva. Metal-clad; manually or electrically operated. Type MI-9. General Electric Co., Schenectady, N. Y.

Electrical Distribution

Busbar Support—Heavy duty, 7,500-volt bus support to carry eight 8x¼-in. copper bars. Lower insulator mounts on steel I-beam and side-supporting insulator on concrete wall. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

Transformer—Type CSP; 1½-50 kva., in voltage classes 2,400-13,800, single-phase. Deion gaps give protection against lightning. Self-protecting against short circuits or overload. Westinghouse Electric and Mfg. Co., East Pittsburgh.

Electrical Protection Devices

Circuit Breaker—Type DX-20 Rated at 50,000 kva. High-speed, inclosed mechanism. All poles in single tank. Furnished for 600 amp. at 15 kv., 1,200 at 7.5 kv., and 2,000 amp. at 5 kv. Condit Electrical Mfg. Corp., Boston.

Fuse Cutout — Indicating, secondary fuse cutout. Rated, 250 volts, 100 amp. Interrupting rating, 3,000 amp., 60 cycles. General Electric Co., Schenectady, N. Y.

Lightning Arrester—Type C. Size, 9,000 volts, non-grounded system. For crossarm or flat mounting. Pyrex glass body. Line Material Co., Milwaukee.

Reclosing Cutout—"RLO." Has adjustable time delay. Two- and three-fuse units. For voltages up to 15,000 in 50- and 100-amp. sizes. Line Material Co., Milwaukee.

Exhaust Systems

Exhaust Fans — Multi-blade type. Have two operating speeds. Steel mounting rings. Totally inclosed motors. Sizes, 16-30 in.; motor horsepower, 1/20-½. A.c. and d.c. models. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis.

Fan — Made of Haveg, a molded plastic resistant to non-oxidizing acids and weak alkalis. Four sizes, in capacities 500-10,000 cu.ft. per min. Continental-Diamond Fibre Co., Newark, Del.

Filtering, Clarifying, Mixing

Disperser—For production of emulsions, dispersion of liquids and solids, and dispersion of gases in liquids. Can be used for batch or continuous operation. Employs extreme turbulence. Motor-driven. Lancaster Processes, Inc., 443 Fourth Ave., New York.

Mixer—Can be equipped with various kinds of stirrers. For stirring paint and similar materials. Provides stir-

ring facilities after material is transported. Electric motor. Patterson Foundry & Machine Co., East Liverpool, Ohio.

Separator — Separates liquids from chemical vapors or gases. For pressures 150-600 lb. Five sizes; flange sizes 4-14 in. Directing vanes impart rotary motion which causes moisture to separate. Hagen Corp., Bowman Bldg., Pittsburgh.

Separator, Magnetic—For wet material such as glazes, clay slips, and enamels. Powerful stationary magnet holds removable cartridge of auxiliary magnets. Capacities, 500-2,000 gal. per hr. Magnetic Mfg. Co., Milwaukee.

Separator, Magnetic—Type CF for fine powders. Number of intense magnetic zones in inclined plane. Iron is separated and dislodged from poles into screw conveyor by wiper traveling across face of magnet. Dings Magnetic Separator Co., Milwaukee.

Sludge Collector — "Circuline," for circular, centrally fed settling tanks. Scraper flights, connected to two strands of chain, are carried by centrally pivoted steel bridge which is operated by motor. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

Food

Evaporator, Milk — Stainless steel; vacuum pan type. Has uniflow coils, horizontal entrainment separator, and counter-current, floor-operated condenser. In all sizes up to 6-ft. diameter. Arthur Harris & Co., 212 North Curtis St.. Chicago.

Homogenizer — Two-stage homogenizer for dairy products. Pressures ranging 150-550 lb. Few holes to clog. Gardner Dairy Equipment Corp., Grand Rapids, Mich.

Oven—Gas- or oil-fired, traveling tray oven for bakeries. Range of sizes with trays 9-22 in. deep. Has one or more combustion chambers, depending upon size of oven. Manufacturer claims oven is explosion-proof. Read Machinery Co., Inc., York, Pa.

Washer and Sterilizer — Electric water heater and steam sterilizer for dairy equipment. Heater is mounted on hinged bracket on end of wash tank. Steam generator produces steam in 3 minutes. Strauss Electric Appliance Co., Waukesha, Wis.

Grinding and Buffing

Grinder — Bench type. One 6-in. coarse and one 6-in. fine wheel. Totally inclosed motor; ¼- and 1/3-hp. sizes, 110 volts, 60 cycles. Brown-Brockmeyer Co., Inc., Smithville Rd., Dayton, Ohio.

Grinder — Portable worm thread grinder. Crank handle gives angular adjustment to right or left. Handwheel raises and lowers grinding spindle. Second handwheel for motor adjustment. Sizes, 1, 3, and 5 hp. for any voltage, a.c. or d.c. Hisey-Wolf Machine Co., Pittsburgh.

Grinder—No. 51 grinder and buffer. Handles 4x1-in. grinding wheel or 4x2-in. buffing wheel. Squirrel cage motor for 3-phase, 220-volt, a.c. line. Motor for 110 volts can be supplied. Buckeye Portable Tool Co., Apple St., Dayton, Ohio.

Grinder—"Speedwitch" flexible-shaft grinder. Has ⅓-hp., 18,000-r.p.m. motor. Can be used with ⅛-in. collets. Takes grinding wheels up to 2 in. Can be used for mold, metal pattern, and die work, and for cleaning welded joints. Charles L. Jarvis Co., Gildersleeve, Conn.

Grinder, Bench—Six-inch, ball bearing "Handy" grinder with adjustable tool rests. Has capacitor-type motor, totally inclosed. Motor rated ¼ hp., for single phase, 110 volts, 60 cycles. Heavy duty model has ½ hp. motor, for single- or 3-phase lines. Baldor Electric Co., 4351 Duncan Ave., St. Louis.

Grinders—Line of pneumatic hand grinders. Three sizes, giving speeds of 3,000, 3,400 and 5,800 r.p.m. Straight or spade handle. Cleveland Pneumatic Tool Co., East 78th St., Cleveland.

Instruments and Meters

Flow Indicator — Clamps over pipe with flexible paddle inserted into hole cut in pipe. Electrical contact, housed above paddle, can be used to sound alarm or operate relays, starting or stopping equipment. Autocall Co., Tucker Ave., Shelby, Ohio.

Flow Meter—For low pressure service. Measures flow of oil, chemicals, or air. Sizes: 1-4-in. pipe connections; capacities: 7-175 gal. per min. or 9-220 cu.ft. per min. of air. Schutte & Koerting Co., North Twelfth St., Philadelphia.

Industrial Analyzer—Measures amperes, volts, and ohms. Shunts for 7½, 75, 750 amp. Voltage ranges 150, 300, and 750. Ohm range can be read from 0.1-20,000 ohms. Westinghouse Electric and Mfg. Co., East Pittsburgh.

Meter—For measuring all kinds of liquids used in food industries. Sizes for measuring up to 300 gal. per min. Can be furnished in corrosion-resisting materials. Pittsburgh Equitable Meter Co., 400 North Lexington Ave., Pittsburgh.

Pyrometer—"Optimatic." Automatic optical pyrometer. Indicates temperature in less than ½ sec. Can measure temperatures of moving objects. Minneapolis-Honeywell Regulator Co., Fourth Ave., Minneapolis.

Pyrometer, Optical — Self-contained, direct-reading precision instrument. No connection charts. Master lamp furnished for calibration. The Pyrometer Instrument Co., 103 Lafayette St., New York.

Separable Well-Tube System—"Thermospeed." Protects temperature-sensitive bulb from corrosion while preserving speed of bare bulb systems. For use in recording thermometers and control instruments. Taylor Instrument Cos., Rochester, N. Y.

Temperature Control — "Wheelco." Flag on pointer passes through field of coil in oscillator circuit affecting grid excitation of electron tube. Change actuates mercury-tube relay. Thermo Control Devices, Inc., Milwaukee Ave., Chicago.

Thermometers — Universal Socket Dial. Type 61 is self-contained instrument with inclinable dial. Type 62 is distant-reading type with 6 ft. of connecting tube. Scale ranges available from —20 to +800 deg. F. Jas. P. Marsh Corp. 2073 Southport Ave., Chicago.

Thermostats—Two. No. 1000-W Strip Type is rated at 1,000 watts a.c., 220 or 110 volts. Pencil Type rated at 2,000 watts, a.c.; 900 watts, d.c., 220 or 110 volts. George Ulanet Co., Columbia St., Newark, N. J.

Lubricants and Lubricating Devices

Grease Guns—Two models added to "Rock Crusher" line. RA-40, air-operated, delivers 11-18 oz. per min. at 150-200 lb. air pressure. RL-40, electric, delivers 9 oz. per min. Alemite Division, Stewart-Warner Corp., 1870 Diversey Parkway, Chicago.

Materials

Ceramic Material — "Nepheline Syenite," a ceramic raw material. High alumina and low iron content. Great Lakes Foundry Sand Co., Detroit.

Plastic—Durez 75 Series. Waterproof. Also claimed to withstand immersion in alcohol solutions. General Plastics, Inc., North Tonawanda, N. Y.

Steel—Ultimate tensile strength of 70,000 lb. per sq.in. Corrosion resisting. Available in sheets, bars, and other forms. "Hi-Steel." Inland Steel Co., First National Bank Bldg., Chicago.

Wax—Synthetic. Eight grades. Melting points range 143-184 deg. F., acid number 0.56-11.10, ash 0.29-4.44 per cent. Werner G. Smith Co., West 110th St., Cleveland.

Materials Handling

Can-Tilting Rack—For 5-gal. cans. Holds round or square containers. Built of steel. Collapsible. Morse Mfg. Co., Inc., Syracuse, N. Y.

Chains—Heavy-duty transfer chains for handling billets, bars, plates and the like in steel mills. Alloy, heat-treated steel. Chain Belt Co., 1669 West Bruce St., Milwaukee.

Conveyor Belt—"Griptop." Has special rough surface on rubber cover for handling boxes up inclined conveyors. In widths up to 36 in. The B. F. Goodrich Co., Akron, Ohio.

Hoist — Model CA Peerless. Outer shell of high tensile aluminum. Steel chains, hooks, and gears. In ¼-, ½-, and

1-ton sizes. Regular or quick-speed gearing optional in each. The Harrington Co., Philadelphia.

Hoists—Electric Monorail mounting. Frame of rolled steel shapes. Gear case is split horizontally to allow inspection. Automatic, disk-type, mechanical load brake. Electric motor brake on hoist motor. Northern Engineering Works, Detroit.

Trolley Wheel—For tramrail systems. High strength, iron casting has slight crown on wheel tread to bring wear on flange in from the outside. Double row, shielded-type ball bearings. The Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland.

Truck, Lift—Dolly truck with platform that can be raised through 9 in. by operating removable crank arm from either end of truck. Capacities up to 800 lb. Platform measures 24x20 in. Rubber-tired casters. Lifting table, mounted on wheels, also available. Lewis-Shepard Co., Walnut St., Watertown, Mass.

Mechanical Power Transmission

Belt — Cords imbedded in rubber which is covered by single ply of duck on each side. Square-cut edges. Widths up to 24 in. in five or more plies. United States Rubber Products, Inc., 1790 Broadway, New York.

Belting — Grooved flat belting. "Nucord." Grooves placed one inch apart, parallel to sides of belt, lend flexibility that distributes cross and lateral strains over all cords of belt. Ten cords per inch of belt width. Nucord Co., 605 West Washington Blvd., Chicago.

Belting—Round leather belting with groove into which hook fits, leaving no projections outside of belt diameter. "Clark Hook Groove." Victor R. Clark Belting Co., 605 West Washington Blvd., Chicago.

Clutch—Hydraulic clutch for heavy forging machinery. Multiple-disk, friction type. Small, high-speed motor supplies pressure for clutch. Ajax Mfg. Co., Lakeside Ave., Cleveland.

Hydraulic Hose—For hydraulic power transmission. Internal tube of oil-resisting rubber, three plies of braided wire, one layer of braided cotton, and cover of rubber. Sizes ⅜-1¼ in. The B. F. Goodrich Co., Akron, Ohio.

Metal Finishing

Abrasive Cleaning Equipment — A number of tables, upon which castings or metal stampings are placed, that progress as a conveyor and revolve under Wheelabrator blast. "Wheelabrator Multi-Rotary Table." Speed is variable. American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind.

Burnishing Barrel — Mercil Type. Barrel, gearing, and motor contained in one unit. May be operated at any angle. Splashproof. Cover-lifting device and support. Switch mounted on front of frame. Hanson-VanWinkle-Munning Co., Matawan, N. J.

Dryer, Centrifugal—For plated work. Two basket sizes: 12x12 in. and 18x18 in. Motor of ½ hp. drives turntable at 600 r.p.m. Hanson-VanWinkle-Munning Co., Matawan, N. J.

Metal Cleaning Machine—For attachment to production machines. Cleaning compound is alkali wash or oil slush. Has 1-hp. motor. Dimensions 3½x2½x3½ ft. Metalwash Machinery Co., 27 Haynes Ave., Newark, N. J.

Zinc Plating—"Mazic" process. Heavy deposits from cyanide solution give bright finish. Manufacturer claims fast process. Hanson-VanWinkle-Munning Co., Matawan, N. J.

Metal Working

Automatic Screw Machine — "Di-Matic" Model A. Two non-indexing spindles with draw-in collets of 1½-in. capacity. Indexing arm and cross-slide are actuated by cams. Each spindle has own forming, finish forming, and cutting-off tools. Seven operations can be performed simultaneously. Windsor Automatic Co., Inc., Windsor, Vt.

Bar-Straightening Machine—Straightens tubing up to 6 in. with ¼-in. wall, and 4-in. bars. Driving rolls independently adjustable. All grades of steel can be handled. Sutton Engineering Co., Park Bldg., Pittsburgh.

Chucking Machine—Model RP. In 4- and 6-spindle types. Pushbutton control of chuck by operator's left hand while he positions piece with right. Centerline of spindle is 44 in. from floor. National Acme Co., East 131st St., Cleveland.

Cut-Off Machine — For removing gates and risers from hard alloy castings and for cutting bar stock and tubing. Has 10-hp., totally inclosed, fan-cooled motor, V-belt drive, 2 speeds, 20-in. cutting wheel. Cyril A. Fox, Oliver Bldg., Pittsburgh.

Cutting Machine—Model 320 wet-abrasive cutting machine for long cuts through flat materials and bar stock. Single, rectangular cast pedestal. Vertical movement of wheel controlled by hand crank. Motor of 5 hp.; V-belt drive. American Chain Co., Inc., Bridgeport, Conn.

Die-Casting Machines — Two high-pressure, hydraulic, brass die-casting machines. Controls are interlocked. Type 2G has maximum die space of 24 in. and minimum of 8 in.; type 8G has maximum space of 17 in. Reed-Prentice Corp., Worcester, Mass.

Die-Sinking Machine — For grinding and cutting applications. Can be fitted with rotary files or shaped grinding wheels. Countershaft-driven. Speeds. 850-14,000 r.p.m. Mall Tool Co., Chicago Ave., Chicago.

Edge Conditioner—Conditions edges on slit-metal coils. Sharp edges left by slitting machine are rolled smooth. Both edges of 8 slit strips can be rolled simultaneously. The Yoder Co., Cleveland.

Electric Furnace—Pit type. For clean normalizing, spheroidizing and bright annealing. Alloy pots are supported independently of charge. Designed for treating of coils of steel wire. Electric Furnace Co., Wilson St., Salem, Ohio.

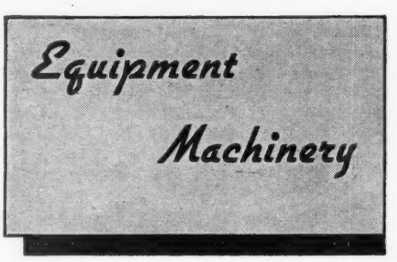
Flask—For foundries. Made of magnesium alloy. Light-weight, strengthened corner construction, specially designed pin pad taking any standard pin. American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind.

Furnace, Hardening—"P.D.M." high-speed hardening furnaces in single- and twin-chamber models. For gas or oil burners. Single-chamber model can be used in conjunction with separate heat-treating furnace. Philadelphia Drying Machine Co., 3351 Stokley St., Philadelphia.

Furnace, Heat-Treating — Hot gases are made to circle pieces in process of treatment 2½ times before leaving furnace. Flame does not impinge on pieces. Several sizes. Lindberg Engineering Co., Union Park Ct., Chicago.

Furnaces, Heat-Treating — Box type. Metallic resistors of Smith Alloy No. 10 for 2,400 deg. F. Will operate with either oxidizing or reducing atmospheres. Atmosphere control prevents infiltration of outside air. Hevi Duty Electric Co., Highland Ave., Milwaukee.

Grinder, Piston—No. 101. Finishes both straight and cam pistons. Designed for fast operation and heavy duty. Rapid set up and chucking. Number of speeds available at wheel- and work-heads. VanNorman Machine Tool Co., Springfield, Mass.



Lathe, Turret—High speed lathe for quantity production and small lots. Maximum swing is 18½ in. Spindle is driven by V belts; speed is changed by replacing sheave with another of different diameter. Push-button panel on headstock provides control of spindle. Turret automatically indexed. Gisholt Machine Co., Madison, Wis.

Pipe Machine — Model-A Special. Cuts, threads, reams, and chamfers all sizes of pipe ⅛ to 2 in. Will operate geared tools to cut and thread 2½-12-in. pipe. Cuts ¼-1-in. round bars. Universal, 110-volt, 25-60-cycle motor. Beaver Pipe Tools, Inc., Warren, Ohio.

Pipe-Threading Machine—Dual speed for "bucking up" operation. Motor with 1,200-r.p.m. speed provides spindle speeds through gear box of 8-28 r.p.m. for thread cutting. Second motor through geared head gives speed of 260 r.p.m. and spindle speed of 2 r.p.m. for "bucking up." Landis Machine Co., Inc., Waynesboro, Pa.

Pouring Furnace—Direct lip pouring furnace. Oil or gas fuel. No. 93 Simplex. Has geared motor. Capacity up to 5 tons; adaptable for almost any metal. Monarch Engineering & Mfg. Co., Baltimore.

Press—"A-1¼ Inclinable Press." For light metal stampings. Has 14-point engagement sleeve clutch. Flywheel and throwout spindle mounted on anti-friction bearings. Clutch has positive stop, locking device and single-stroke mechanism. Niagara Machine and Tool Works, Buffalo, N. Y.

Press—Wholly automatic high-speed punch press for light work. Has slicer-

feed attachment. Motor drive and special gearing for very slow feed. Perkins Machine Co., Warren, Mass.

Press, Hydraulic—Uses oil as hydraulic fluid. Pushbutton starts pump and single lever is used for operation. Four sizes, ranging from 40 tons with 12-in. square platen to 100 tons with 14-in. square platen. Pump and motor drive housed in base. Watson-Stillman Co., Aldene Rd., Roselle, N. J.

Tapping Unit—Improved No. 3 automatic unit. Equipped with 2-, 3-, or 5-hp. motor. Positive reversing clutches designed to reverse at 500 r.p.m. Shockless reversing. Taps six ¼-in.-20 threads in steel or six ⅜-in.-11 threads in malleable iron. Millholland Sales & Machine Co., Indianapolis.

Tumbling Barrel — So designed that sawdust and parts being tumbled are held in barrel until barrel is reversed. Discharge then automatically takes

Materials Supplies

place into sloping discharge pan which is vibrated to separate sawdust. N. Ransohoff, Inc., West 71st St., Cincinnati.

Miscellaneous

Bottle Cleaning Machine — Duo-Blo. Two bottles at a time are placed against nozzle openings on front of machine. Blowing nozzles slide into bottles and shoot blast of filtered compressed air. Dirt collects in bag inside of machine. Karl Kiefer Machine Co., Martin St., Cincinnati.

Blueprinting Machine—For exposing blueprints, brownprints, and direct process prints. Uses 3½-amp., 50-in. mercury vapor tubes. Upright console design with pedestal type base. Finished in olive green baked enamel. Variable-speed motor. Can be connected to 110-volt a.c. or d.c. line. The C. F. Pease Co., 813 North Franklin St., Chicago.

Cleaning Machine — For degreasing and cleaning metal parts, leather goods, and stator coils. Has revolving cylinder into which clean solvent is introduced. Has evaporator and distilling equipment with which to clean solvent. Can also dewax small motors. Rochester Engineering and Centrifugal Corp., Buffalo St., Rochester, N. Y.

Crusher — Reduction crusher will crush materials for open hearths or blast furnaces to ½ in. Action is compression, not grinding. Two sizes: one has rating, 15-25 tons for ½-in. setting; other, 30-40 tons for ½ in. setting. The Bonnot Co., Canton, Ohio.

Door Opener—"Magic Door Operator." Uses photoelectric cell which operates relays causing door to open and stay open until opening is clear. Stanley Works, New Britain, Conn.

Lead Bonds for Castings — Lead bonded to cast-iron pipe and fittings by means of new flux. Bond is about ¼ in. thick. Andrews Lead Co., Greenpoint, Long Island City, N. Y.

Magnets—"Alnico." Permanent magnets of aluminum, nickel, cobalt and iron. Holes for mounting or soft steel insert are cast in. Simonds Saw & Steel Co., Lockport, N. Y.

Oil Pump — For cutting oils and coolants. Vacuum dome provides priming. Capacity, 5 gal. per min. at 600 r.p.m. Belt-drive. Hudson Mfg. Co., Oshkosh, Wis.

Paving Plates—For installation on surface of concrete slabs as protective surface. Of ⅛-in. rolled steel. Two types are identical, but one has button-head studs to make it non-skid. Bethlehem Steel Co., Bethlehem, Pa.

Pulverizer—For laboratory or small production jobs. "Mikro-Pulverizer"; 8-in. Fine or coarse grinding. Has 3-hp. motor. Pulverizing Machinery Corp., Roselle Park, N. J.

Pump—Direct-connected, centrifugal pump for coolants. Capacity, 4 gal. per min. Low-pressure pump powered with ⅛-hp. motor, high-pressure unit with ½-hp. motor. Adapter base for side wall mounting available. Acme Machine Products Co., Inc., Muncie, Ind.

Vibrator—Has two offset weights mounted on shafts so geared that they revolve in opposite directions at same speed. Use of two weights permits directional control of impulses. Alloy, heat treated steels. Ajax Flexible Coupling Co., Westfield, N. Y.

Molding

Hydraulic Press—Uses oil as fluid medium. For plastics and rubber molding. Capacity, 100 tons. Platens, 60 in. wide, 30 in. deep. Steam and hydraulic gages inclosed behind shatter-proof glass in face of top crosshead. Farrel-Birmingham Co., Inc., Ansonia, Conn.

Motors

Motor — "SR." Single-phase motor with smooth torque-speed curve. Ratings 1, 1½, 2 and 3 hp.; 1,725 r.p.m. Armature has both squirrel cage and repulsion windings. The Emerson Electric Mfg. Co., St. Louis.

Packaging

Bag-Filling Machine — Model B-9; fully automatic. Bags opened and formed and moved along beneath several chutes from which measured quantities drop. Bag is then folded and sealed. Carton Machinery Corp., Newport, R. I.

Cappers — Semi-automatic, portable cappers for caps 10-90 mm. "Kinex." Tightens screw caps to any desired tightness. Suspended from ceiling or bracket. Can be used over 4-ft. length of conveyor. Ludcke Corp., Watertown, Mass.

Packaging Machine—Packs cans in paper cases. Cans fed through intake conveyor; cases are placed in machine in knockdown form. Machine delivers 10-20 completely sealed cases per minute. J. L. Ferguson Co., Jasper St., Joliet, Ill.

Sheeting — Transparent, waterproof, and greaseproof. Available in rolls, stock sheets, and cut sheets. Standard colors. American Products Mfg. Co., 8131 Oleander St., New Orleans.

Paint and Painting Equipment

Lacquer — Heat resisting. Can be heated to above 350 deg. F. before it will give off odor. Color is black. Good adhesion to metal. Stanley Chemical Co., East Berlin, Conn.

Primers—Valdura enamelized metal and Valdura wood primers. Former for prime coating metal surfaces in damp and wet locations. Latter for old and new unpainted wood surfaces. The American Asphalt Paint Co., East Ohio St., Chicago.

Rust Preventives — "Penlaco Rust Preventives." Varnish-like compounds which are spread on metal surfaces by wiping, brushing, dipping, or spraying. Transparent. Penola, Inc., Pittsburgh.

Spray Gun—Type MM. For all types of painting. Easy cleaning for single unit; detachable spray head is only part touched by paint. Two-finger trigger. The Alexander Milburn Co., 1416 West Baltimore St., Baltimore.

Paper Making

Filter—"Wright Cord Filter." For filtering news print stock. No filtering cloth or covering wire required. Filter is non-clogging. Self-priming pump removes filtrate producing vacuum of 15-21 in. Goslin-Birmingham Mfg. Co., Inc., Birmingham, Ala.

Piping, Valves and Fittings

Pipe Joint—Flexlock Joint for use with specially constructed ceramic pipe in services up to 15 lb. per sq.in. pressure and temperatures not exceeding 175 deg. F. The B. F. Goodrich Co., Akron, Ohio.

Strainers—For pipe lines. Has rotary scraper within cylindrical screen, affording cleaning without removal. Sizes: ¼-8 in. Sarco Co. Inc., 183 Madison Ave., New York.

Tubes—Seamless, alloy steel tubes and pipe. "B & W Croloy 25-20." Chromium, 25 per cent, nickel, 20 per cent. For continuous operation at temperatures up to 2,100 deg. F. Babcock & Wilcox Tube Co., Beaver Falls, Pa.

Valve, Oil Regulating—Type G. For use on heat treating and forging furnaces. Valve has scale and pointer so that burner operation can be duplicated. Mahr Mfg. Co., Minneapolis.

Valves—Improved line of forged steel globe valves. For pressure ratings up to 1,500 lb. Cone or plug type. All wearing parts renewable. Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.

Valves—Line of stainless steel valves. Gate, Y, globe, angle, and cross types. For pressures of 125 and 150 lb. "Aloyco." Alloy Steel Products Co., West Elizabeth Ave., Linden, N. J.

Power Plant Equipment

Boiler Protector—Shuts down boiler if water level goes down too far or pressure becomes too high. Fused switch assembly. Detroit Lubricator Co., Detroit.

Gas-Air Mixer—Keeps ratio of gas and air for combustion constant. Manual regulation of valve controlling rate of gas flow to inspirator. Philadelphia Drying Machine Co., Philadelphia.

Generator—Driven by 4- or 6-cylinder diesel engine. Available in any standard cycle or voltage. Sizes 20-45 kw., at 900 or 1,200 r.p.m. Storage battery (24-volt) used for starting. Cummings Engine Co., Columbus, Ind.

Packing — Plastic. Placed on flange joints in place of gasket. Suited for use in refrigerating equipment. Not affected by acids, alkalis, benezine, gasoline, oil, hot or cold water. Haas Brothers, Washington St., New York.

Pump — Variable-displacement pump with two adjustable feeds and constant displacement pump are incorporated in single housing. Single shaft drives both pumps. Sundstrand Machine Tool Co., Rockford, Ill.

Pump, Centrifugal — For corrosive liquids. No. ZP-1. Metal parts protected by ceramic materials. Designs for belt drive and for direct-motor connection. Maximum capacity reached at 2,500 r.p.m. General Ceramics Co., Rockefeller Plaza, New York.

Steam Return System—Motor-driven, with one moving part. Returns steam at any pressure and at temperatures ranging 275-350 deg. F. American District Steam Co., North Tonawanda, N. Y.

Stoker, Underfeed—Consists of twin units that can be run independently, giving protection against forced shut down. Design also makes possible shallow fire bed, and permits use of low air pressure. For all types of boilers. Whiting Corp. Harvey, Ill.

Viscosity Indicator—Constantly indicates viscosity of fuel oil passing to burners. After setting, any viscosity change is indicated and can be corrected by manual or automatic control of steam. Sterling Engine Co., Niagara St., Buffalo.

Safety Equipment

Goggle — Featherweight Dowmetal goggle. Adjustable nosebridge. Easy interchanging of lenses. Lenses available for every type of hazard. C. H. Dockson Co., Detroit.

Hat—Made of vulcanized fiber. Set on leather cradle to provide shock absorption. Leather peak. Sizes 6-8. Portable Lamp & Equipment Co., Pittsburgh.

Sanitation

Washfountains — Enameled, pressed-iron wash fountains. One circular unit has 36-in. diameter. One semi-circular unit has 54-in. diameter. Accommodate 6 persons. Hand- or foot-control of water. Bradley Washfountain Co., Milwaukee, Wis.

Water Cooler—For drinking water. Elimination of pre-cooling by means of waste water from bubbler permits use of ¾-in. straight drain, reduces chances of clogging. Model FWP-8 supplies 25 gal. per hr. with inlet water of 60 deg. F., Model FWP-14, 42 gal. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Textile

Loom Equipment—Converts 2x2 or 4x4 box loom into automatic loom, giving one pick from each of three shuttles in succession. William H. Baker, Boston St., Boston.

Ribbon Loom — Single-shuttle loom for weaving cotton, rayon, tinsel, and elastic ribbons up to 1⅜ in. in width. Each loom of one shuttle forms separate unit, with automatic stop-motion for both warp and filling. Saentis, Inc., Union City, N. J.

Spray Gun—For spraying flock or dry powders. Manufacturer claims that it will not clog. Round or flat spray. Type GPRF. Paasche Airbrush Co., 1901 Diversey Parkway, Chicago.

Warp-Knitting Machine — "Super Tricot." Can operate at 300 r.p.m. and 40 racks per hour. Can handle silk, rayon, cotton, or wool, producing fabrics ranging from light nets to heavy overcoatings. Available in widths 72-180 in. Collins Loom Works, Inc., Amsterdam, N. Y.

Tools and Supplies

Lamp Guard — Vapor-proof trouble-lamp guard. Eight 3/32-in. steel wires affixed to two heavy steel rings. Outer end brass nut holds wires and a steel hook. McGill Mfg. Co., Valparaiso, Ind.

Pipe Detector—Locates underground pipes of iron or steel. Surveying compass, adjustable bar magnet, and two radial fins turning with compass, constitute apparatus. General Electric Co., Schenectady, N. Y.

Pipe Threaders — Ratchet diestocks. Two models for adjustable dies, two for solid dies. Right and left hand. Pawl trigger instantly reverses ratchet. Self-centering guide. Armstrong Mfg. Co., Bridgeport, Conn.

Toggle—Spring toggle has two wings engaging a trunnion nut, and spring that forces wings outward. Diamond Expansion Bolt Co., Inc., Garwood, N. J.

Valve Tools—For placing new seats in worn valves and faucets. Carrying case contains taps, fixed-center guides, special facing tool, seat keys, ratchet wrench. Economy Valve Seat Co., Fletcher St., Chicago.

Vise—No. 97-1600 horizontal, universal vise. Top part fastened to universal bracket, can be moved or turned around. All surfaces ground square. Capacity: 4 in. with hardened jaws, 5 in. with jaws removed. Covel Mfg. Co., Benton Harbor, Mich.

Wrenches—"Non-sparking" wrenches of heat-treated, drop forged beryllium-copper. Single- and double-head types. J. H. Williams and Co., 75 Spring St., New York.

Wrenches—Set No. AA-1 containing combination set of wrenches and hand tools. Number of pieces is 138. Bonney Forge & Tool Works, Allentown, Pa.

Welding and Cutting

Welder Control—For "Wonder Arc Welders." Dial switch control has amperage marked on switchboard. Electrical control between contacts cannot be shorted. Miller Electric Co., Inc., Appleton, Wis.

Welding Positioner — P-10. Tilting turntable handles pieces up to 4 tons. Has 48-in. manually revolved table, locking in 50 positions. Tilts 90 degrees in one direction and 45 in the other. Tilting accomplished by a.c. or d.c. motor. Harnischfeger Corp., 4525 West National Ave., Milwaukee.

Wire and Wiring Devices

Connectors—Two. No. 00 will take two No. 16 or three No. 18 wires. No. 0 will take several combinations ranging from two No. 14 to seven No. 18 wires. Molded cap screws over metal wire holder. Rattan Mfg. Co., New Haven, Conn.

Plugs and Receptacles—Rated: 600 volts, 100 amp. "Jumbo-Type." Tapped for 2-in. conduit. Two-, three-, and four-pole combinations. Delta Star Electric Co., 2400 Block, Fulton St., Chicago.

Woodworking

Saw—For sawing holes ⅞-4½ in. in wood, plywood and other materials, using either hand drill or drill press. Replaceable blades. E. C. Atkins & Co., Indianapolis.

Slat Slotter—For slotting slats of all kinds, especially those of Venetian blinds. Vertical movement of motor adjustable for length of slot. Machine furnished in any desired multiple. The Woodworkers Tool Works, South Jefferson St., Chicago.

TRADE LITERATURE

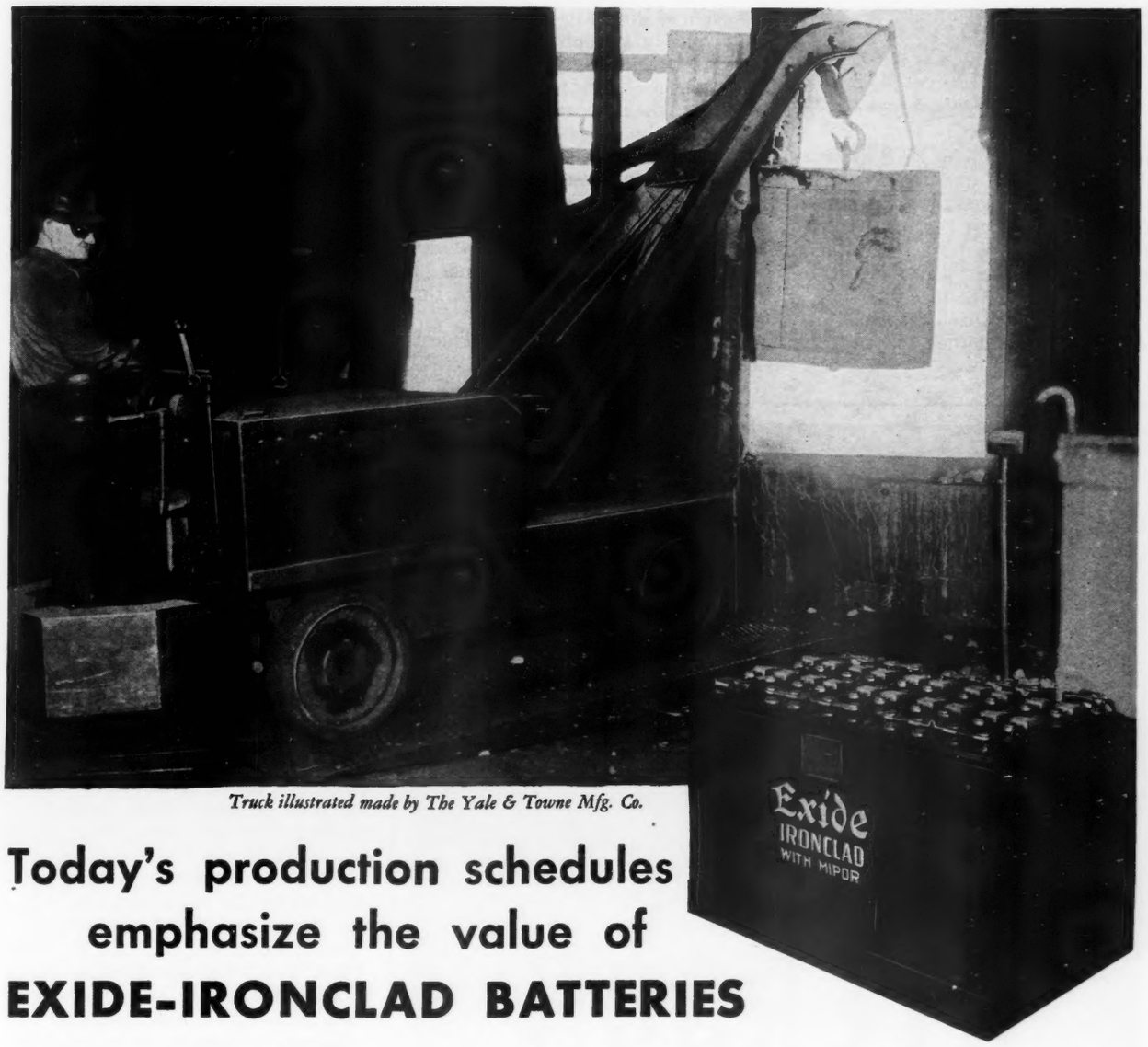
AIR CONDITIONING—Folder, on corrosion-resisting Toncan iron for air conditioning equipment.—Republic Steel Corp., Massillon, Ohio.

AIR TOOLS — Bulletin B1-36, showing line of air tools for painting, finishing, sanding, etc.—Paasche Airbrush Co., 1909 Diversey Parkway, Chicago.

BALL BEARINGS—Data book, containing engineering data on ball bearings.—Bearings Co. of America, Lancaster, Pa.

BELTING—Folder, on Nucord multiple flat belt drive. — Nucord Co., 605 West Washington Blvd., Chicago.

(Continued on advertising page 56)



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Electric industrial trucks can work harder and faster and longer when they are powered by Exide-Ironclads. These batteries have demonstrated their ability to stay on the job all day long. Their enormous reserve power enables them to handle with ease exceptional loads and grades. Their sustained high voltage means productive operating speeds throughout an entire shift.

Exide-Ironclads are economical. Long life, low maintenance costs and freedom from service interruptions combine to cut your costs when using Exide-Ironclads.

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Let Exide-Ironclad Batteries improve your materials handling service and cut costs. Write for free booklet, "Facts for Consideration in Selecting a Battery."

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WITH EXIDE MIPOR SEPARATORS

"MIPOR," Reg. U. S. Pat. Off.

Stocking Up on Quality

(Continued from editorial page 100)

ning the oven too long. For any machine with a bad quality record, the reports of the inspection department are transmitted to the maintenance department as part of the data on which to base decisions to adjust, rebuild, or replace the machine.

Under decentralized responsibility, it has been altogether too easy for foremen to get used to small drifts from quality. To be sure, little defective work got by the final inspection in the last department, even then. But the number of seconds was unnecessarily increased. The new plan, detaching inspection from the immediate problems of production, brought such things to light and made it possible to readjust the defective machine, instruct the worker who did not fully understand his job, or get at other difficulties that nibbled at quality standards.

For example, one of the delicate operations in the industry is the knitting of the instep, toe, and heel onto the leg, which has been knit as far as the instep on another machine. If the tension applied to the second knitting machine, the footer, is not exactly equal to that of the first, the legger, the result will be the appearance of a tight or loose foot.

With stitches running 60 or 70 to the inch, and with the further complication of differences in sheen and shade of the yarns used at the junction, this adjustment of tension was altogether too delicate to be left to unaided eyesight. Rejections proved that. A device was therefore worked out that enables each foreman to view, through a strong magnifying glass, a silhouetted sample of the juncture of leg and foot, and thus, much more easily and accurately, to detect slight differences in the tension of the two. Also, a master tester was designed and is used daily for check-up of tension adjustments. This machine projects on a screen a silhouette of the junction, much enlarged.

Faster and Better Testing

Approval of purchased materials was also put under the inspection department, and the laboratory was set to work on tests. New methods of testing dyes were developed, faster and more dependable than those used in the past. Incidentally it was found that under the old system, by which the final approval of a purchase of dyes often rested with the foreman, there had been considerable variation in the purity and intensity of dyestuffs. The department had been equipped to make tests, but the tests were slow, and had often been deferred until the dyes were needed. As a result, if the dye proved to be sub-standard, the foreman had the choice of getting along with it or of possibly holding up a rush order. Systematic routines in receiving and testing removed that difficulty.

Other interesting possibilities presented themselves to the department in the investigation of dyestuffs. There is an endless field for new developments and combinations in such possibilities as the simultaneous dyeing of two fibers in different colors. For instance, a silk stocking clocked with mercerized cotton may come out of a bath with the silk one color and the cotton a contrasting shade.

Constant work is created for the research department by changes of color demanded by fashion. A particular neutral shade of tan may result from immersion in a bath containing, in proper proportions, dyes of three different colors. Each dye

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may be absorbed differently by a particular combination of silk fibers, and may exhaust differently at particular temperatures. Such problems provide not only a steady grist of routine work for the laboratory, but endless possibilities for research and new developments.

The program has proved more than satisfactory in finding and removing the numerous causes, either inherent or accidental, that were swelling the percentages of seconds to be sold at reduced prices. It has had another useful result. The constant impartial check-up by the inspection department, the repeated recounting in the monthly meetings of spectacular savings in this department or that, savings often made by mere youngsters, relatively speaking, have had their effect. More than one foreman who came to the meetings self-satisfied and sure that no improvement was possible in his department, went away to wonder. And presently the research department was called in, and there was a new saving to discuss in meeting, and to be chalked up to the credit of foreman as well as research man. Which is not a bad thing for the foreman or the research man, or for the organization.

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Balanced Wage Rates

(Continued from editorial page 106)

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given the full number of points. The rating declines in proportion to failure to achieve what is set as the standard of workmanship.

Full credit under Item No. 3 is given to an operator who can set up his machine without any assistance. The more assistance, the lower the number of points. If a man is entirely unable to set up his machine or prepare his workplace, no points are allotted.

Versatility as to product, process, or machines—Item No. 4—entitles a man to the full 5 points when he is capable of handling all the jobs and machines in the department. If he can handle only his own present job, he is allotted only 1 point. However, as he learns and advances in his work, this rating is increased.

Merit rating for length of service is on the basis of 1 point per year of continuous service until a maximum of 5 points has been reached for 5 years' service.

Item No. 6—safety, conduct, sobriety and attendance—is the most difficult to evaluate. A worker who can be definitely classed as a regular employee, based on his record of attendance and punctuality, whose conduct has been impeccable, and who has a good accident record, receives the full 5 points.

Table I. Merit Point Ratings

Item 1. Performance as to quantity produced	75
Item 2. Performance as to quality of output	5
Item 3. Ability to prepare a machine or work place and make set-ups	5
Item 4. Versatility as to product, process, or machine	5
Item 5. Length of service	5
Item 6. Management's rating based upon safety, conduct, sobriety and attendance.	5
Total	100

5. Determining Individual's Rate

Total merit points of a workman determine what percentage of the base rate for the group in which he falls will be his hourly rate.

To reward a workman for improvement in any of the six items that make up his total merit ratings, and to protect the management

WHAT'S NEW IN HANDLING?

Logan heavy duty roller conveyor handling steel coils weighing up to 10,000 pounds from storage to pickling. Spark plugs or coils of steel—there is a type of Logan equipment for doing the job.

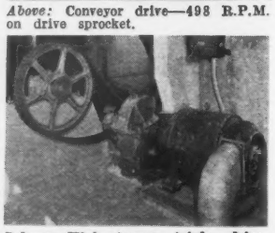
● In factory, warehouse or shipping department—an increasingly important question. And rightly so. Every plant engineer and production executive is interested in current developments in Conveyors—because of the intimate relationship between better handling methods and efficient plant operation. In fact, it is not unusual for improved methods of handling to make the difference between operation at a loss and operation at a profit. The nearest Logan representative (there is one in your locality) will be glad to discuss "What's New" in Conveyors with you. Just write LOGAN CO., Incorporated, 510 Buchanan St., Louisville, Kentucky.

Logan Conveyors
LOUISVILLE

A drive exposed to moisture, steam, dust or grit is a natural for Baldwin-Duckworth roller chain. Here are two such drives, installed in the dust-laden air of a grain elevator—yet they have run for years without attention under conditions that would speedily destroy other types of drives. Baldwin-Duckworth Roller Chain will give the same uninterrupted service on any such drives in your plant.

Baldwin-Duckworth standard roller chains and sprockets in varying sizes and types will operate effectively up to 4,000 R.P.M. and will transmit up to 500 H.P. Our engineers will advise you on selection and installation. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

Above: Conveyor drive—498 R.P.M. on drive sprocket.



Below: High torque triple drive. Note enclosed ventilation protection needed by motor.

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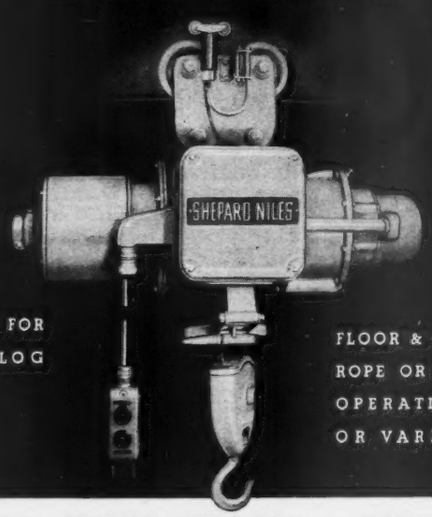
1/4 TO 20 TONS CAPACITY



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ROPE OR PUSH BUTTON
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against a slump on the part of the workman, the merit rating of each employee is reviewed every 30 days. The rating for the period just closed determines his hourly rate for the next period. When these periodical reviews have been completed, each employee is told what his new merit rating is and what his new hourly rate for the next period will be.

Table II. Ratings for Quality of Production

Per Cent of Standards	*Merit Points*
80- 84 (incl.)	60.0
85- 89	62.5
90- 94	65.0
95- 99	67.5
100-104	70.0
105-110	75.0
Over 110	Special Consideration

When this simple plan was described to the workmen by the foremen, it was found that they had no difficulty in grasping the justice of it. Even those workers who found that they were going to get a lower rate than formerly usually admitted its fairness and exerted themselves in order that their rating and hourly pay would be increased for the next period. The method provides a simple and direct incentive, not only to increase production, but also to make the man a better workman.

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Depreciation Dollars

(Continued from editorial page 109)

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preciated assets are assessed upon greater income than others having newer equipment.

In actual practice the concerns with more modern equipment and having the greatest proper depreciation charges are usually the largest profit makers, even after they have charged all the depreciation that the "law allows." These concerns actually pay the largest share of our corporation income taxes.

One of the most serious consequences of the lack of provision for depreciation is illustrated in connection with our railroad locomotives. Railroads generally do not set aside depreciation reserves for locomotives but depend upon expenditures for repairs and reconditioning to maintain values equivalent to their original investments in these units. The result of this general practice is that a large proportion of our locomotives are more than 20 years old; relatively few are less than ten.

Many of our older locomotives

have been reconditioned, repaired, and reconstructed until very little of the original locomotive remains visible. Except for improved accessories the locomotives are still old locomotives and have not been improved at a rate to keep pace with our general progress.

This is rather definitely demonstrated in the recent development of a few streamlined trains of special design throughout, constituting radical departures from established types of locomotives and passenger cars. It is significant that these trains have been developed chiefly by the use of funds borrowed from the government because the railroads lacked depreciation reserves that could have been used for the purpose had the practice of setting aside such reserves prevailed.

It is quite generally accepted by users of business trucks and automobiles that these transportation units need replacement within 4 to 6 years, yet relatively few owners actually set aside depreciation reserves to insure funds available for replacements when needed. They depend rather upon the possibility of the funds being available through profits that may have been earned or through ability to borrow the necessary funds when required.

There is a ready means for making industry and business conscious of the necessity for setting aside actual cash reserves for the purpose of replacing depreciated value of buildings, machinery, and depreciable equipment.

It is only necessary for the government to recognize that depreciation reserves are exactly what the name implies and that using these reserves or any part of them for other purposes is in reality equivalent to treating them as profits.

Briefly stated, it would only be necessary for the Federal Government to establish a ruling that any depreciation reserves not actually set aside for or actually used to replace depreciated plant or equipment shall be treated as profits and taxed accordingly in income tax assessments.

Apparently, even though industrial executives tend to utilize depreciation reserves as a basis for holding income taxes down to minimum dimensions, they are a long way from recognizing depreciation reserves as constituting a definite reality. The government can quickly bring home to them the importance of recognizing the reality of these reserves by taxing as net income any such bookkeeping reserves as are not proved to be real.

More Proofs

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The latest Hoover—Model 300

Spray-Finishes HOOVER ELECTRIC CLEANERS

Today, more than ever before, the successful manufacturer is interested in modernizing his equipment. For only by modernization can he improve his product and at the same time reduce costs. Modern DeVilbiss Spray-Finishing Equipment is playing a big part in this program. If you are interested in better finishes and increased efficiency of production, investigate the latest developments in new, modern DeVilbiss Spray-Finishing and Exhaust Equipment.

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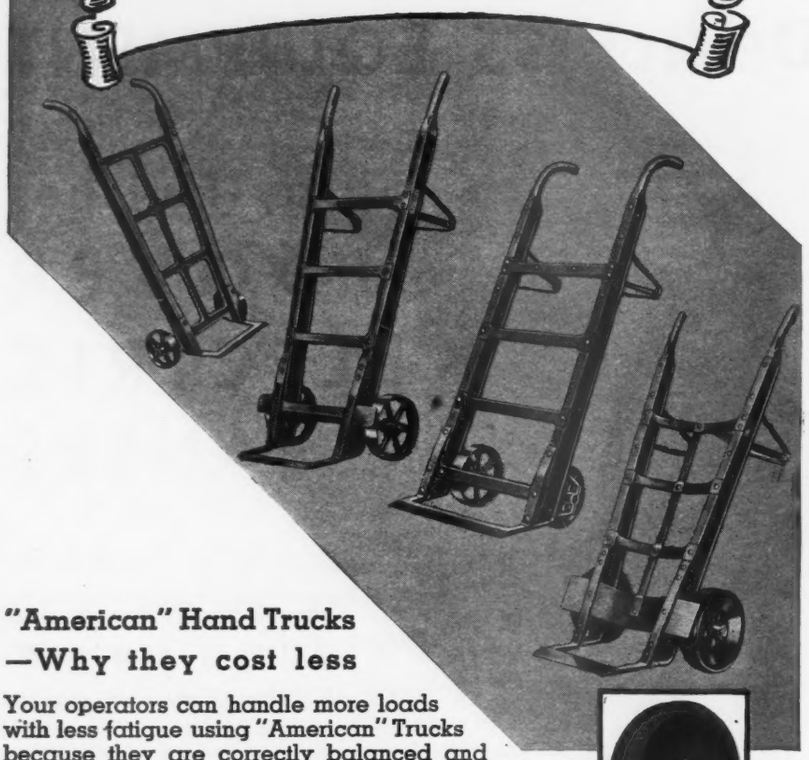

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Your operators can handle more loads with less fatigue using "American" Trucks because they are correctly balanced and roll on accurately turned true-running wheels. Maintenance expense is negligible because light, strong, tough steel has replaced wood construction. "American" Trucks are assembled from formed parts securely bolted together, so that if a member does become damaged through accident or abuse, it can be replaced easily and by an unskilled workman.

The labor saving, floor saving, rubber-tired, roller-bearing "American" hand truck wheel.

With "American" Trucks you can be sure of getting the greatest return from your labor investment in the men who push your trucks. There's an "American" Truck for every material handling need. Select the one *you* need from the American Catalog. Write now!

THE AMERICAN PULLEY COMPANY
4200 Wissahickon Ave., Dept. 4, Philadelphia, Pa.

AMERICAN
PRESSED STEEL
HAND TRUCKS

Gold in the Water You Waste

(Continued from editorial page 119)

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are wasted down the drain. Quite often the drying oven may be heated by piping this residue of water and condensate through coils.

Cost of installation against savings is, of course, the factor in determining whether a proper condensing and cooling tank should be provided. Such installations should be made with care, however, for there is the unfortunate example of a large rubber company where an expensive installation was made and promptly discarded because of a change in processing.

Some plants build apparatus that must be filled with water for testing purposes. Generally when the test is completed this water is run down the drain. The maintenance engineer should take thought to see whether it can be piped to a tank and used again, or used for some other purpose.

Water is freely used for cooling spot welders, special types of dies, molding machines, and so on. In many instances the outflow can be piped to plating or dip room or to a central reservoir of mill water.

Those Leaky Faucets

Leaks and faucets left running are troublesome. At their mention management pricks up its ears and demands that something be done to stop them. The maintenance engineer becomes irritated to find continual reminders on his desk that such-and-such a faucet is leaking or was found running in some hole-and-corner place about the plant.

It's easy to send a millwright around to put new washers on the leaky faucets, but what about those continually left running? One naturally thinks of automatic faucets, but to install these entails expense. Therefore, it is advisable to find out how much water is being lost, and what economies can be made by using self-closing faucets.

In most plants many of the runs to faucets are ½-in. pipe. A test, carried out by a qualified engineer of a large municipality to determine the water discharge from ½-in. pipe at 30-lb. pressure, produced these figures.

35-ft. pipe, 815 gal. per hr., or 586,800 gal. per month.

100-ft. pipe, 458 gal. per hr., or 329,760 gal. per month.

When using such figures, however,

from CLEAN AIR

New sources of profit come when you purify the air in your plant with a Coppus Air Filter (proven by dust-counts of filtered air to deliver cleaner air than any other commercial filter).

1. SIZEABLE RECOVERY OF DRY PRODUCTS, otherwise lost in the air in processing. Highly profitable in soap plants. Rich possibilities in metals, chemicals, etc.

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3. PROTECTION OF MACHINERY from dust-caused wear.

4. PREVENTION OF OCCUPATIONAL DISEASES due to dust.

Write for full facts—Bulletin F-320-3 on unit type filters, F-350-1 on *the only self-cleaning dry filter,* the DRY-MATIC. And put up to us any problems that might be solved by air filtration.

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IN SWEET'S also BLOWERS AIR FILTERS HEAT KILLERS STEAM TURBINES

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one must bear in mind the fact that the rise of the pipe, elbows, projections in fittings, back pressure, valves, and so on cut the flow far below theoretical maximums. Then, too, throttled leaks will have discharge figures wholly different from those of pressure leaks.

It is important to note how much water is wasted through leaky faucets. An average leak runs about 35 drops to the minute. This is equivalent to 0.66 pints per hour or approximately 60 gal. per month. As the rate of leakage increases, the drops merge into a stream when they come with a frequency of about 120 to the minute. Such a stream flows at the rate of approximately 200 gal. per month, and if water costs 20 cents per thousand gallons, the monthly cost is four cents per faucet.

In this day of budgets the maintenance man finds himself confronted with the accounting department's complaint that the water bill should be in definite ratio to production, and that "the ratio was exceeded last month." Why?

It simply means that some department is wasting a lot of water and a check-up is needed. Water meters must be put in the lines, departments billed according to what they use, and offenders pointed out.

Often meters cost more than the management wants to spend. This difficulty may be overcome by renting meters from the water company or the manufacturer. Usually they may be obtained for nominal rentals. A good plan is to put the meter on the supply lines to the department you suspect is wasting water and say nothing about it for a month. Then have the accounting department bill them for the exact amount of water used. The next month you will get results.

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No Windows and Why

(Continued from editorial page 115)

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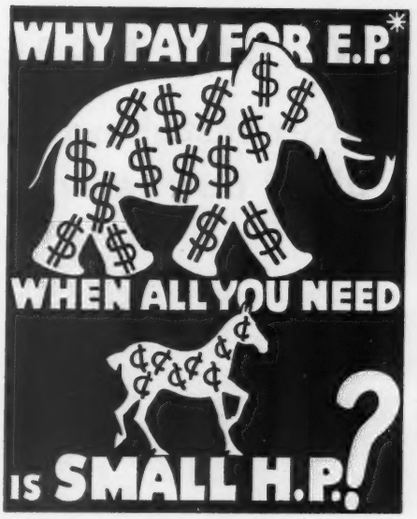
and the cork is painted white to aid light reflection. Care has, of course, been taken not to close the pores of the cork, the idea being that the sound goes in and around, but never comes out. Special acoustic plaster has been used in one of the offices where most of the really noisy business machines are located. Both cork and plaster have helped materially to cut down on the usual office clatter.

Air conditioning, of course, is a *sine qua non* in this type of build-



*Elephant power (that is, high horsepower), as in large turbines.

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You save by buying a turbine that just fits your needs on small jobs. You don't have to pay for a lot of horsepower you'll never need, as you would with a large turbine on small jobs.

The Coppus line, almost alone, offers you six sizes *(and six prices)* up to 150 H.P. They're the least expensive good steam turbines you can buy.

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REMEMBER — TURBINES PREVENT SPARKING DANGER IN EXPLOSIVE ATMOSPHERE, CUT POWER COST, CAN'T BURN OUT FROM OVERLOADS

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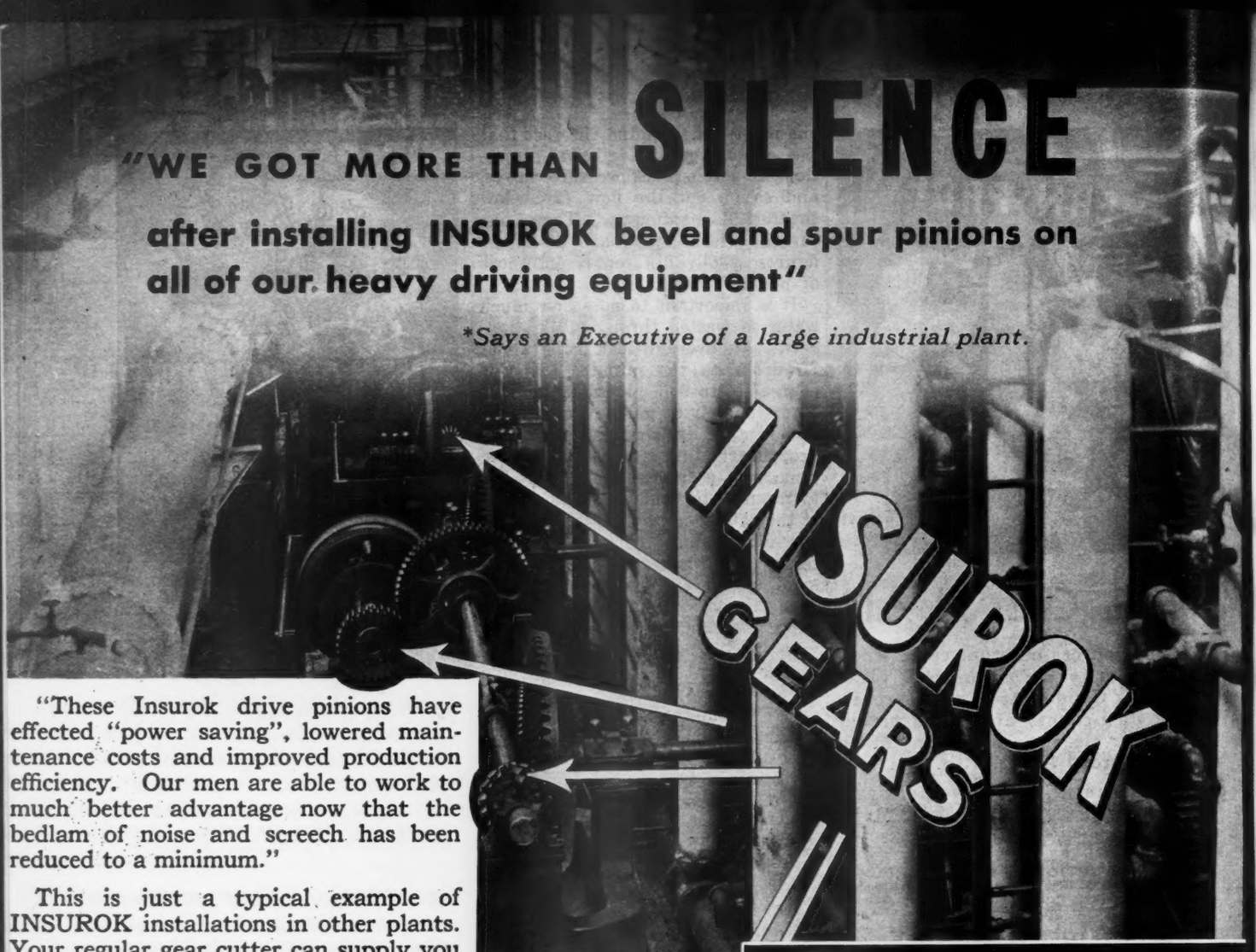
"WE GOT MORE THAN SILENCE

after installing INSUROK bevel and spur pinions on all of our heavy driving equipment"

**Says an Executive of a large industrial plant.*



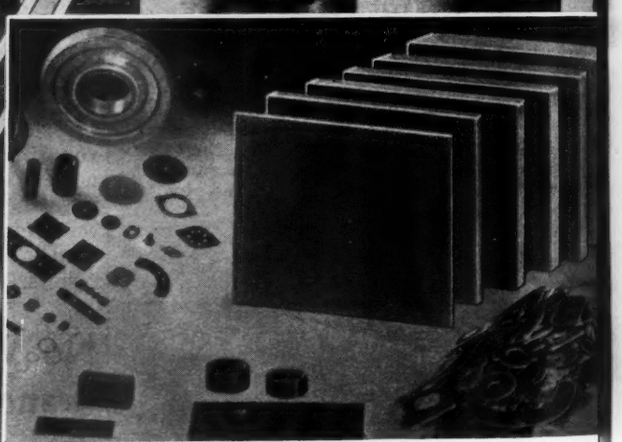
"These Insurok drive pinions have effected "power saving", lowered maintenance costs and improved production efficiency. Our men are able to work to much better advantage now that the bedlam of noise and screech has been reduced to a minimum."

This is just a typical example of INSUROK installations in other plants. Your regular gear cutter can supply you with any quantity of INSUROK gears in the style and of the size to fit your requirements.

Millions of pieces from the tiniest simple designs to the largest intricate precise shapes, some weighing more than a hundred pounds, are molded or laminated every month in the plants of the Richardson organization, the largest in the United States devoted exclusively to the plastic arts.

Richardson can supply your every requirement and you may be assured that you will receive the type and quality of plastic parts especially suited for your requirements.

As custom molders of Plaskon, Beetle, Durez, Bakelite, Resinox, Indur, Tenite, and all forms of synthetic resin plastics, the resources of our Research Laboratories, Design and Engineering Departments are at your command.



INSUROK "a superior laminated phenolic product", in sheets, punchings, gear blanks, pump valves, fabricated parts, in grades and thicknesses for countless applications. Insurok may be sawed, drilled, turned, punched, tapped, planed, milled or sheared with perfect ease . . . . readily fabricated in your own factories.

**Name on request.*

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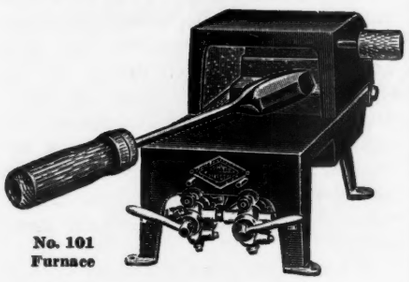

No. 101 Furnace

Heats Soldering Coppers
Heat-treats Steel Tools and Parts

Designed for heating coppers up to 12 lbs. per pair and heat-treating carbon steel tools and parts. Made of heavy cast iron with heavily-lined fire-box. Lining is heavy refractory material which insures maximum fire-box temperature. Embodies additional exclusive Johnson features. Write for full details.

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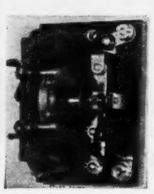
TIMING DEVICES

THEN

Did you know that..

NOW



one of the first forms of timing device—the sun dial—is known to have been in use about 700 years B. C.? (Isaiah xxxviii:8)

Also, did you know that Struthers Dunn, Inc., for many years has been supplying leading manufacturers with standard and special timing devices in Thermal, Motor Driven, Air Dash Pot, Inertia, and Capacitor types?

Let us figure on your requirements.

Write for Bulletins P-38 and P-54

STRUTHERS DUNN INC
149 N. JUNIPER ST. PHILADELPHIA, PA.
DUNCO MEANS DEPENDABILITY

ing. Two separate systems take care of it. One, already installed, supplies conditioned air to the office part of the building; the other, in process of installation, to the printing department, paper storage, etc.

95 Outdoors, 80 Inside

Refrigeration equipment for each of the two systems is practically identical, consisting of Freon compressor direct-connected to a 125-hp. synchronous motor. Each operates in connection with shell-and-tube condensers and water coolers. From each of the two water coolers, refrigerated water is pumped to air washers which condition various zones in the building. The aim is to maintain a summer condition predicated on outdoor temperature variations, so that people entering or leaving will experience no unpleasant shock. This is done by using differential thermostats which are set so that when outside temperature is 70, indoor temperature will be 72, and for each 3-deg. rise, the indoor temperature will be increased 1 degree. Which means, if my arithmetic is right, that when it's 95 in the shade outdoors it will be around 80, maybe as high as 83 inside, which at, say, 48 per cent relative humidity, is mighty comfortable in hot weather and plenty of reason why I'd be willing any day to give up my magnificent view.

The air washer for the main floor of the office part of the building is in the basement, and conditioned air is supplied to ducts furred in above the hallways to be distributed to offices, lobby, and corridors. Air is returned through grilles in the lower part of offices doors into the hallways, from which it is drawn back to the air washer.

Second floor is similarly conditioned by an air washer located in a penthouse on the roof. Insulated air supply ducts running across the roof distribute the conditioned air to plaques in the second-floor ceiling. Air is returned to the washer for reconditioning from grilles on the floor line of the west end.

A minimum of 15 cu.ft. of outside air per person per minute is introduced into the offices to insure freshness, with complete change of air every eight minutes.

The second system, now being installed to handle the printing department, is similar to the first in compressor capacity — 135 tons of refrigeration. It has, in addition, a well-water air-cooling system that serves printing, cutting, and locker rooms. Well water at 55 deg. is pumped to an air washer at the rate

WORTHINGTON MULTI-V-DRIVE

with GOODYEAR EMERALD CORD BELTS

FOR any type of equipment ...Worthington Multi-V-Drive provides an effective solution for many drive problems.

- Positive grip
- Permanently quiet
- Ideal for close centers
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● CORRECTLY RATED
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● ACCURATELY MADE

FROM fractional horsepower ratings up, there is a Worthington Multi-V-Drive for every power and purpose.

25,000 STOCK COMBINATIONS ...UNLIMITED SPECIALS

Write for this valuable manual . . . complete data for M-V-D selections

WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: HARRISON, NEW JERSEY
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WORTHINGTON

KOPPERS

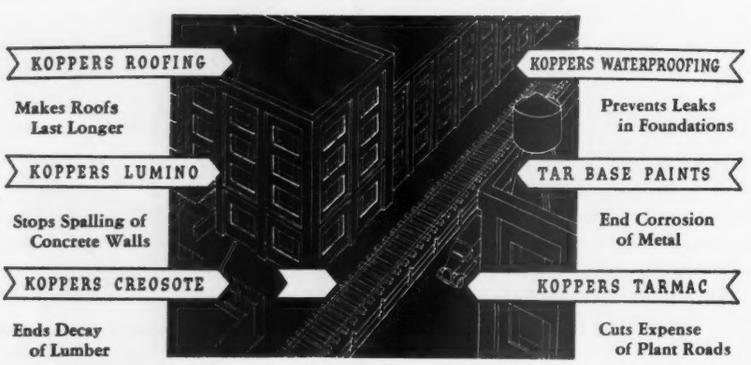
MAKES YOUR ROOFS LAST LONGER

YOUR roof is the fifth "wall" of your building. It must withstand as many destructive forces as the other four walls, and extra ones besides. It should be more durable than any of the walls. Often it isn't . . . but it can be.

FLAT roofs of Koppers Coal Tar Pitch and Felt are guaranteed to last 15 or 20 years. Many like them have lasted 30-40-50 or more years. Coal tar pitch and felt should always be specified for flat roofs. Send the coupon below for details.

KOPPERS PRODUCTS COMPANY, PITTSBURGH, PA.

HOW KOPPERS SERVES FACTORIES



KOPPERS PRODUCTS COMPANY
Pittsburgh, Pa. F-3

Please send me information on: ☐ Koppers Roofings. ☐ Lumino for Spalling Concrete. ☐ Dampproofing and Waterproofing Foundations. ☐ Creosote. ☐ Tarmac for Plant Roads.

Name _____

Address _____

of 830 gal. per min. Storage and lunch rooms are cooled by an air washer served by the mechanical refrigeration unit.

The building is heated by extended surface steam coils, reheaters being installed with the washers and preheaters being used to bring up the temperature of all outside air introduced. Air control dampers are pneumatically operated, and are arranged so that the change-over from summer to winter operation can be made by means of a single hand switch.

Which leaves exactly room enough to tell about the neat way in which Hershey office employees are kept informed as to the state of the weather. This is really an important point, too, however trifling it may sound. Suppose five o'clock came around and you got way down to the front door and then found it was raining so you had to go back for your umbrella or your rubbers. Then multiply yourself by 300, the number of Hershey office employees, and picture the resulting congestion and confusion. Well, all that is avoided by a simple system of tiny signal lights under the clock, one red, one white, one green. Seven combinations are thus possible. White means clear; Red is rain. Red and white stands for cloudy. Green is snow. And so on. All three lights 10 minutes before quitting time means umbrellas, rubbers, overshoes, raincoats are very much in order.

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This Motor or That?

(Continued from editorial page 126)

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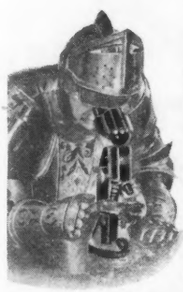
ways the same for different ratings, nor even for duplicate ratings. These variations in speed, however, affect only a few applications.

Starting current is the current inrush to the motor at the instant voltage is applied. It is comparatively high for a moment, but drops off rapidly as the motor comes up to speed. The first inrush is the "locked rotor" current and is what a meter would read if the rotor were kept from turning. When the rotor is free to turn the current drops off so rapidly, since the motor comes up to speed quickly, that a meter connected in the circuit reads less than the actual inrush.

The Edison Electric Institute recommendations for maximum permissible starting currents are based on the locked-rotor values. The "free-rotor" values are defined by E.E.I. as 75 per cent of the locked-

How Good Are You at Twisting? Bending?

Probably, *this will not be the last time we put this question to Readers of FACTORY*



This is the première of the Roxalin Blue Knight. Quite naturally, we look upon this event as calling for an informal introduction.

In 1924, we introduced Roxalin *Flexible* Finishes. The abuse-tests which these AIR-DRY Lacquers (in BLAX, Colors and Clear) survive are sensational!

The booklet we send to interested executives describes these materials and furnishes case-data. You can put on a demonstration at your desk which shows finish "stamina."

Some unique applications . . . .

Super-Bowling Pin finish by Roxalin —Smack and sock of ball—Rough handling by pin boys—Abrasion-resistent Blue Knight Finish stays on!

Blue Knight *Flexible* Finish on aluminum fan blade—in constant temperature steam oven at 212° F.—for TWO YEARS! Started to be an accelerated aging test to induce brittling. No go!

A handsome lustre is imparted to galoshes—rubber "feel" disappears. Stretch and Give do not disturb Roxalin *Flexible* Finish!

We could go on and on! But similar evidential tests can be drawn for the other finish-classifications which, CELLULOSE or SYNTHETIC, are engineered for specific performance.

Convincing Test Data in this FREE *Booklet. ASK!*

We send, FREE on request, a booklet entitled, *"How Good Are You at Twisting and Bending."* This booklet describes tests and gives full information on *Blue Knight Flexible* (AIR-DRY) Finishes. You also receive actual metal strips which you can twist, bend, fingernail, or abuse. Address your letter to ROXALIN FLEXIBLE LACQUER CO., Inc., * 800-6 Magnolia Avenue * Elizabeth, N. J.

ROXALIN *Flexible* FINISHES

CELLULOSE & SYNTHETIC TYPES
ENGINEERED FOR SPECIFIC PERFORMANCE

KINNEAR Rolling GRILLE

An Impassible Barrier
with the operating convenience of a
Window Shade

. . . . for stock room, shipping department, gateways, office building—or any other place where protection against trespassing, burglary or intrusion is needed. Has the advantage of air, light and vision combined with remarkable strength. Coiling over the opening it is space-saving and convenient. Built in any size or metal and mechanically or electrically operated. The Kinnear Rolling Grille is a permanently installed "modern guard" you'll want to consider.

When in need of doors remember that Kinnear builds the Kinnear Steel Rolling Door as well as other types of upward-acting doors.

Send Today for Complete Details.

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Please send us descriptive bulletin on the Kinnear Rolling Grille. ☐ Also catalog on Kinnear Doors. No obligation.

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rotor values, and are usually the actual readings on a well-damped ammeter when testing a motor installation for starting current.

Speed adjustment for variable output is most economically obtained with d.c. shunt-wound motors. Weakening the field by means of a rheostat will increase the speed. A speed-increase ratio of 2 to 1 or 4 to 1 is common, and 6-to-1 ratio is used on certain drives. The speed of most d.c. motors can be increased to some extent and advantage is frequently taken of this fact to obtain the desired output of the machine. Horsepower rating of the motor, however, cannot in general be increased; so the resulting load at the increased speed must be carefully checked against the motor capacity.

Speed reduction, below full field, is obtained by inserting external resistance in the armature circuit.

Speed reduction can be obtained readily with wound-rotor a.c. motors by secondary-resistance control, and with squirrel-cage motors by multipole winding combinations.

Increase in speed can be obtained with standard induction motors only by increasing the frequency.

When selecting the motor and control for adjustable-speed applications a check must be made on the resulting horsepower, or torque, for the speeds selected. With a fan, for example, the torque varies theoretically as the square of the speed. That is, for 80 per cent speed the torque is 64 per cent and the horsepower 51 per cent of full-load conditions. This is called a variable-torque application.

A positive-pressure blower or belt conveyor is considered as a constant-torque application, the horsepower varying directly as the speed. Machine tools, such as lathes, grinders, and so on are considered as constant-horsepower applications.

Wound-rotor a.c. motors and d.c. shunt motors with resistance type of control for reduced-speed operation are used extensively for the first two types of applications. Special, multipole, squirrel-cage motors and d.c. shunt-wound motors with field control are also available and are usually employed for the constant-horsepower drives.

Machines such as reciprocating compressors that have frequent, wide variations in torque are not good applications for reduced-speed drives with resistance control, on account of the resulting fluctuation in speed.

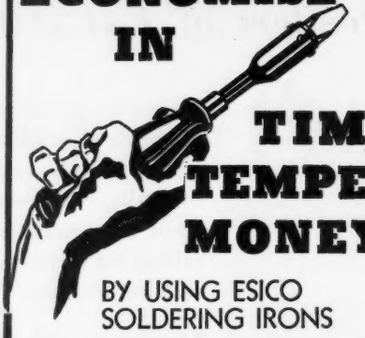
A succeeding article, to appear in an early issue, will discuss the problem of selecting the motor and control to fit the requirements.

Aids remarkably in controlling friction. Often completely overcomes serious heating and fire hazard problems. Increases operating efficiency, cutting maintenance costs to a surprising degree in many cases. Not a mere "break-in" oil; by no means an abrasive.

Use Pyroil regularly. Write for Free laboratory report showing photomicrographic and chart evidence. Also, what many organizations have accomplished with Pyroil. Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Pres., 938 La Follette Ave., La Crosse, Wisconsin, U. S. A.

THIS SIGNATURE ON EVERY CONTAINER

ECONOMISE IN TIME TEMPER MONEY!



BY USING ESICO SOLDERING IRONS

Esico Electric Soldering Irons have long been giving unfailing performance in the country's largest assembly plants.

Equip your production lines with electric soldering irons that are HOT—CLEAN — QUICK SOLDERING — LONG LASTING—*Improve your product—reduce production costs—raise your plant morale.*

Inexpensive Esico Industrial Soldering Irons are available at the nation's leading mill supply, electrical and hardware distributors.

All Esico irons unconditionally guaranteed.

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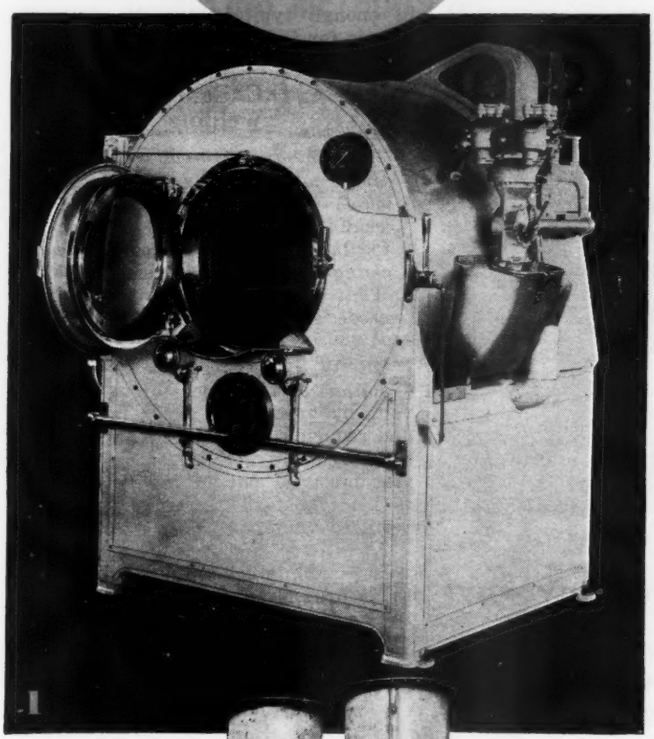
ESICO

FIRST AID TO GOOD MANAGEMENT



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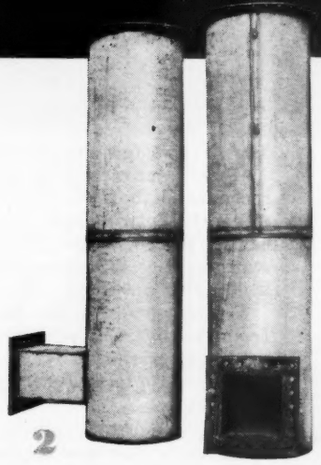

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REPUBLIC'S PERFECTED STAINLESS STEEL

ENDURO, Republic's Perfected Stainless Steel, is helping management in countless industries—lengthening the life of equipment through its resistance to corrosion and high temperatures—improving products because it does not contaminate—minimizing cleaning and shut-down time—reducing maintenance costs—lessening depreciation charges—all making possible increased profits. • Republic ENDURO is available in sheets, strip, plates, bars, tubing and many other forms. Equipment can be made all-ENDURO by the use of rivets, bolts, nuts and welding rod of the same analysis. Fabrication involves no difficulties—few changes in standard practices. • This lifetime metal is stocked by metal jobbers in all large cities. Our metallurgical counsel is at your service to discuss unusual applications.

REPUBLIC STEEL

Republic Steel
CORPORATION
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ALLOY STEEL DIVISION . . . MASSILLON, OHIO

3

4

1 100-lb. capacity washer with inner (perforated) and outer shells of cylinder made of ENDURO Stainless Steel.

2 Gas cracking tanks, electric arc welded of ENDURO Stainless Steel.

3 ENDURO Stainless Steel dyebeam used for dyeing cotton yarns in the warped form.

4 Arc welded annealing box made of ENDURO Stainless Steel.

When writing Republic Steel Corporation for further information, please address Dept. FM.

Simple . . .
Reliable . . .
Widely Adaptable . . .

WESTON

Electrical Tachometers

improve operations and cut costs in many ways

More and more industry is adopting WESTON Electrical Tachometers because this simple, electrical method of rotational speed indication cuts maintenance costs, provides higher accuracy over long periods, and makes possible new methods for increasing plant and machine efficiency.

WESTON Electrical Tachometers consist of but two units . . . a small, sturdy magneto which is driven by the rotating part, and one or more indicators which are calibrated to meet the requirements and wired to the magneto. There are no flexible shafts or other troublesome parts used. Thus installation is quick and simple . . . maintenance reduced to a negligible item . . . and high accuracy maintained over long periods even where vibration is present.

And with WESTON Tachometers, multiple indication, or remote indication is possible. Two, three, or any number of indicators can be connected to the magneto and placed wherever desired. Thus it is practical to maintain close supervision over the speed of fans, conveyors or other machines from remote points where necessary.

Complete data on WESTON Electrical Tachometers, and the many uses for this proved device, is freely offered . . . Weston Electrical Instrument Corporation, 628 Frelinghuysen Avenue, Newark, New Jersey.

WESTON *Instruments*

Questions and Answers

(Continued from editorial page 132)

•

A practical difficulty in many instances is that fixed stock limits can not be set; the correct limits change with every change in price, demand, or other factors. When this is true, or where the quantities are small, it is suggested that computations be made in enough typical cases to establish a basis for judgment. —EDITOR.

Using D.C. Generator for Welding

We have a 110-volt, 300-amp., compound-wound, d.c. generator which we want to use for arc welding. Is it possible to use it for this purpose? If so, will any changes have to be made in it? What size of reactor will be needed? —*F.A.E.*

FOR WELDING service reduce the voltage of the generator to 55 or 60 volts by putting the fields in multiple and reducing the speed, if possible. If the speed can not be reduced a rheostat must be put in the field circuit to hold the field current down to the required value.

A resistor and reactor, preferably with control panel, will have to be used to secure proper current control. A combination resistor-reactor is available, in which the resistor is wound on the core with the reactor so that the correct number of turns is brought out for each current value.

C. J. HOLSLAG
Electric Arc Cutting & Welding Company, Newark, N. J.

WITH a few changes this generator will make a good arc welder. I recommend that you disconnect the series field entirely and use a separate exciter for the shunt field, with a rheostat in series to reduce the voltage for welding to about 45 volts.

Welding leads should be run directly from the brushes, with a 300-amp. reactor in series.

L. C. JONES, *Danville, Va.*

THIS generator can be used satisfactorily for arc welding, provided it is not too much over-compounded. It will be advisable to keep the voltage down to about 65 volts for welding, by means of the shunt field rheostat.

Fairly good regulation of voltage during welding may be obtained by shunting the series field with a heavy, variable resistance, or by the proper combination of fixed resistors. A critical point will be reached where the current will not go sky-high when an electrode sticks and there will be a rapid return of voltage after the arc

(Continued on page 66)

A SYSTEM THAT HANDLES 20,000-ODD BEER CASES DAILY

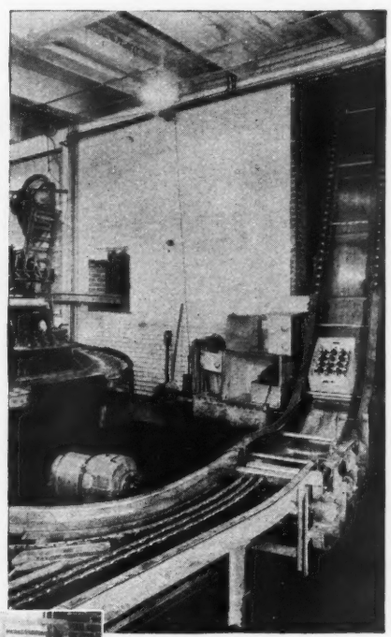
BETTER BUSINESS CALLS FOR BETTER HANDLING METHODS

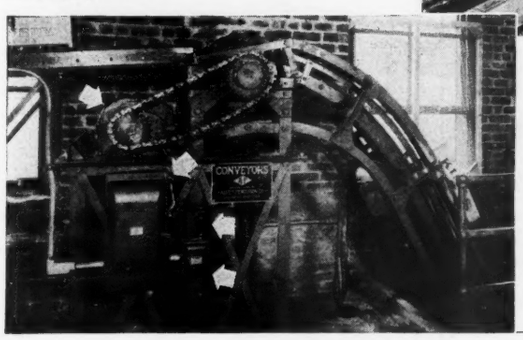
Better business has already begun to tax the delivery service of many plants. What about yours? Whether your factory is running at 50% or 100% of capacity you may find that revised plant layout and modern conveyors, hoists, cranes or other handling equipment can make substantial savings . . . or place you in better competitive position through quicker deliveries.

BETTER EQUIPMENT AVAILABLE

Improved electric control devices insure better speed regulation. New safety features remove old hazards . . . to make conveyors fool-proof. Improved bearings reduce power demand. Conveyor belts of modern design and construction last longer.

Investigate now to make sure you are not overlooking important economies by retaining your present materials handling methods and equipment!





(Above) Junction of two conveyor lines at Kings Brewery—"Completely Conveyorized" . . . writes Mr. C. L. Koehler, General Manager of Alvey-Ferguson . . . "a very extensive system of conveyors, all equipped with Westinghouse Drive which is functioning perfectly."

(Left) View at top of inclined pusher bar booster . . . arrows indicate (from top to bottom) Westinghouse Gearmotor, Line-starter, Push-button Control and Safety Switch.

COMPLETELY CONVEYORIZED

Alvey-Ferguson Conveyors at Kings Brewery, Brooklyn, equipped throughout with Westinghouse Electric Drive.

Meeting mid-summer demand is a major problem of routing and scheduling in this large New York plant, where, during the summer peak, between 22,000 and 24,000 cases of beer are shipped daily.

Here, if anywhere, materials must be handled speedily, efficiently and without interruption. Nowhere along the line can a bottle-neck develop without stopping the entire flow of production.

This complete conveyor system, from malt room to shipping platform, is 100% electrically equipped by Westinghouse.

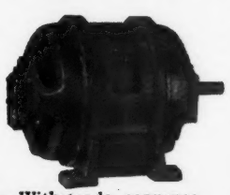
WESTINGHOUSE ELECTRIC DRIVE

Westinghouse Gearmotors power the conveyor through chain drives. Westinghouse Limit Switches automatically synchronize the system and prevent overloading of the various power units. Westinghouse Line-starters, with push-button control and safety switch, complete the installation.

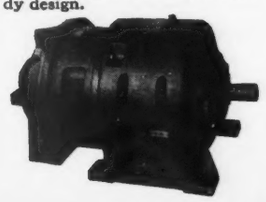
J 20006

SPECIFY COMPLETE WESTINGHOUSE DRIVE FOR YOUR CONVEYOR

CS MOTORS—Especially suited for conveyors because: *Long Insulation Life* — Dual-protected windings withstand moisture, mild chemicals, grit, metallic dust and oil. *Rigid Cast Frame* — Withstands conveyor vibration, supports overhung loads without sag, maintains accurate bearing alignment. *Sealed Sleeve Bearings*—Seal oil in, foreign matter out . . . insure good lubrication.



GEARMOTORS—Reduce space ⅓ to ½. Designed, built and tested as a unit to assure reliable operation. Simple, sturdy design.



CONTROL—"De-ion" Line-starters have good appearance. The arc is restricted to the "De-ion" arc quencher and is almost instantly extinguished. Result—compact design—maintenance practically eliminated

NOFUZE CIRCUIT BREAKERS—Reliable circuit protection without fuse outage waste. Save wasted man hours. Save wasted machine hours. Minimize production delays.

WESTINGHOUSE 1886 W 1936 GOLDEN JUBILEE

A GOOD MACHINE IS WORTHY OF A GOOD DRIVE —

Specify Westinghouse

V-BELT DRIVES

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Specified in all Industry to reduce Power, Maintenance and Production Costs

Our stock assortment consists of nearly 2800 V-Belt Drives from ¼ to 100 h.p., with at least a dozen selections of center distances for each. Sheaves of any size or capacity, or of special construction, can be designed, made and shipped in quick time.

A Wood's V-Belt Drive in a Textile Mill

Woods V-Belt Drives on Air Compressors

WOOD'S PRODUCTS: Shafting, Hangers, Collars, Pulleys, Friction Clutches, Ball Bearings, Flexible Couplings, Rope Sheaves, Pillow Blocks, Belt Contactors, "V" Belts, "V" Belt Sheaves and complete "V" Belt Drives.

Just send a request on your business letterhead, and this new 44-page catalog will come to you —gratis.

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LOW CARBON BASIC AND BESSEMER OIL TEMPERED
WELDING WIRE RODS AND COILS

Sizes ½" to No. 40 WM Gauge (.007)—All Finishes

Wire for Practically All Purposes and Requirements also SCREEN WIRE CLOTH

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FACTORY MANAGEMENT *and* MAINTENANCE
330 West 42nd Street, New York City

(Continued from page 60)

has been struck. Regulation obtained in this manner may be good enough, so that the use of a reactor may not be required. J. G. CRAFT, *Electrician Caribou Mining & Smelting Company Caribou Gold Mines, Nova Scotia*

SINCE the voltage required for carbon arc welding seldom exceeds 40 volts and the metallic arc requires still less, rarely more than 30 volts after the arc is struck, the terminal voltage of this generator could with advantage be reduced to, say, 75 volts. Such a reduction will decrease the amount of resistance required in the arc circuit and thus eliminate the necessity of dissipating a large amount of energy in the resistor.

The terminal voltage may be reduced to a desirable value by reducing the speed, or by reducing the strength of either the shunt or series field by shunting a part of the field current around them.

A reactor will make the arc steadier, but it is not strictly essential for welding. A coil consisting of several turns of heavy wire wound on a sheet-iron core and connected in series with the arc would help to smooth out fluctuations of the arc current.

J. L. YOUNG, *St. Marys, Ohio*

(In considering whether an ordinary d.c. generator can be adapted for arc welding, the character of the service should be given attention. It is frequently possible to rig up a machine that will be more or less satisfactory for some classes of work, and if it is used only intermittently the matter of electrical efficiency may not be important. However, when service is continuous and high-quality work is demanded it will usually be advisable to secure a generator designed for that purpose.—Ed.)

What Causes These Explosions?

An occasional explosion in the hot air furnace that heats our plant seems to indicate improper firing, but we are not sure where the error lies. Fuel is anthracite pea coal. The furnace is fired twice a day by raking most of the red-hot coal to the front and piling up the fresh coal at the rear. The blower is kept running for four or five minutes to get combustion started, but sometimes there is a very annoying explosion. How should our method of firing be changed in order to avoid these explosions? —H.D.

PRINCIPLES of a scheme used in these parts to prevent explosions in blower-operated furnaces are shown in the sketch.

A short piece of platinum wire is placed inside the furnace close to the firepot and kept glowing while the blower is operating, in order to ignite

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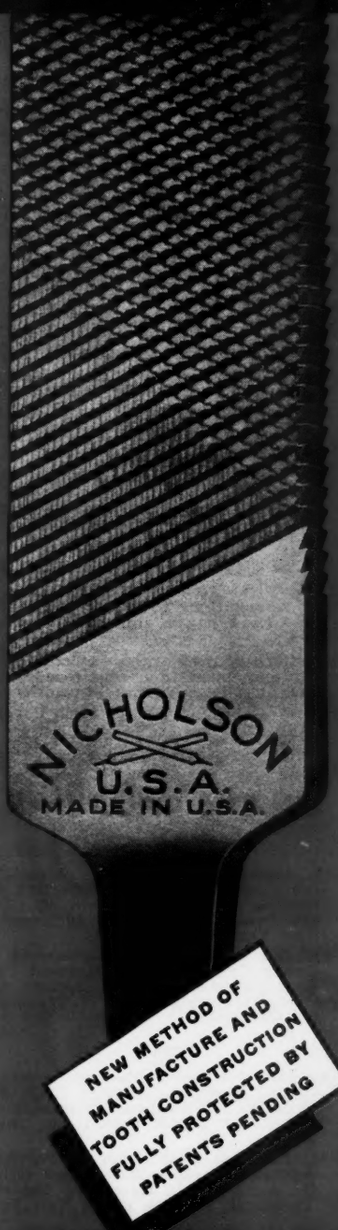

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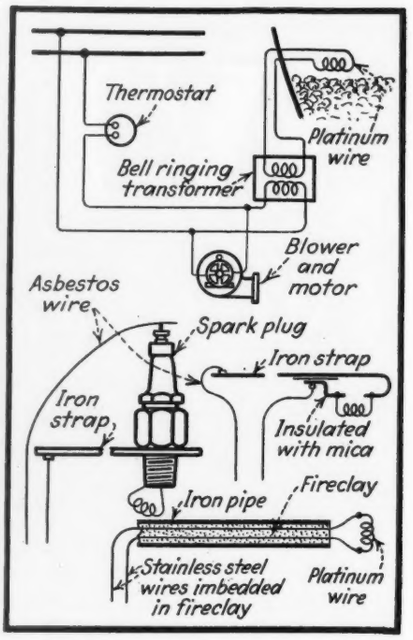

any flammable gas that is formed. As an extra precaution the latch for the firing door is removed and the door is held closed by a long, weak spring.

As shown, several different arrangements are used to hold the platinum wire. All joints in the wire inside the furnace should be brazed.

—J. H. SAUVE, *Temiscaming, Que.*

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BOOKS

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ON THE CALENDAR

APRIL

16-17, American Management Association, Job Order and Mass Production Conference, Cleveland. Alvin E. Dodd, executive vice-president, 20 Vesey St., New York.

20-24, Seventh Midwest Engineering and Power Exposition and Midwest Power Engineering Conference, Chicago. G. E. Pfisterer, secretary, 308 W. Washington St., Chicago.

MAY

11-14, National Fire Protection Association, annual meeting, Atlantic City, N. J. Franklin H. Wentworth, managing director, 60 Batterymarch St., Boston, Mass.

25-28, National Association of Purchasing Agents, Inform-A-Show, New Orleans. G. A. Renard, Executive Secretary-Treasurer, 11 Park Place, New York.

JUNE

22-25, National Association of Cost Accountants, annual convention, Cincinnati. Stuart C. McLeod, secretary, 1790 Broadway, New York.